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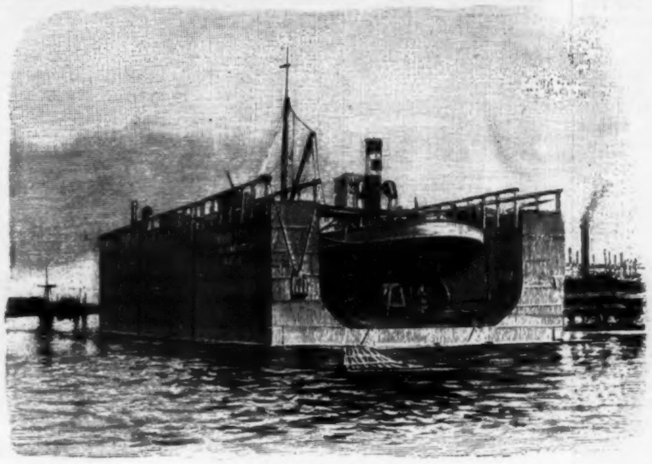
HOW A SHIP IS BUILT.

WHAT are the practical methods used in the construction of a ship and how is it developed from the purely theoretical designs and calculations of the constructors? We will give a few details of the methods at present used in Germany by way of explanation.

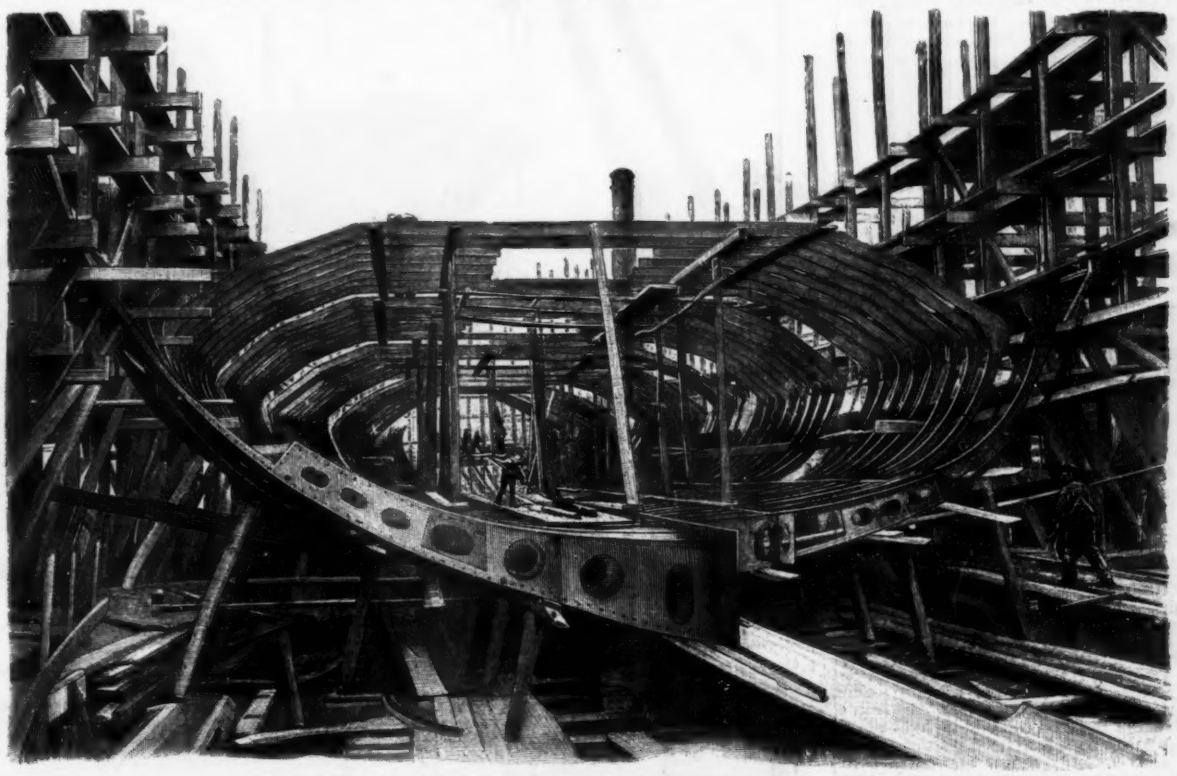
In the first place, the lines of the design, which for the largest vessels are drawn about one-fiftieth full size, must be expanded to full size. This is done on a mould loft floor, a room perhaps 330 feet long by 80 feet wide, on the smooth plank floor of which the lines of the ship are indicated with flexible battens and laths. When a vessel is so large that it is not possible to make the longitudinal lines of full size, they are drawn to half size and the transverse lines to full size. Of course, in this work, the compasses and ruler have to give way to the string and measuring batten. Special care must always be taken in laying out the ribs of the ship, which give it its distinguishing form. Such expanding of the lines of the vessel is a tedious piece of work, requiring weeks for its completion, and only a few skilled workmen are capable of doing it properly. When their task is finished, the real construction of the vessel begins.

German firms are now in a position to supply all the material—the best, soft Siemens-Martin steel—required for the vessels, or at least the men-of-war, built in Germany. This material was formerly bought in England, as German rolling mills were not prepared to deliver it promptly, and nothing is more annoying, or, in fact, more expensive in work of this class than waiting for materials. Besides, English steel was much less expensive, for such heavy weights could be more easily and cheaply transported by sea than by land, and furthermore, Germany did not exact any duty on foreign iron and steel when it was imported for shipbuilding purposes. But now the Krupp works, at Essen, the Gute-Hoffnung works, in Oberhausen on the Rhine, the Hörder rolling mills, and other establishments are prepared to deliver material that is excellently adapted for these purposes and is really preferred to that brought from England, thus placing Germany in a position to turn out vessels which are constructed entirely by German workmen of German material, not even a nail being imported from other countries. Of course, ordinary railroad cars could not be used for transporting plates and angle bars that are often fifty feet long, and therefore the mills have been obliged to build special cars with four, six or eight axles, and for the transportation of the stern post of the "Kaiser Wilhelm der Grosse" it was necessary to build a car of such a shape as to correspond with the shape of the post. These special cars were carried by the Vulcan works from the freight station to their destination in the shipyard by means of ferry boats.

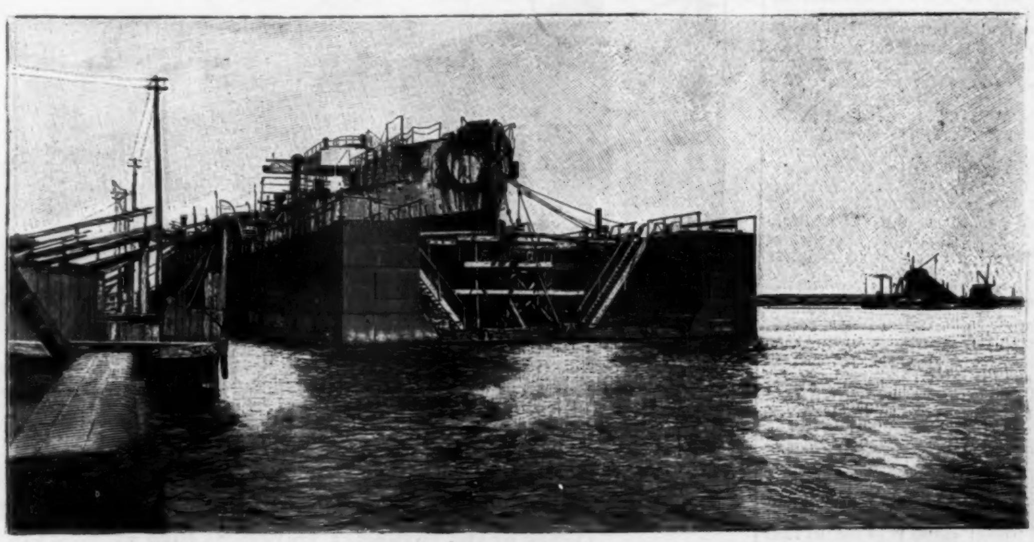


FLOATING DOCK.

Before the steel plates and angle bars can be put in place on the hull they must be carefully prepared. All steel plates for the German navy are first placed in a "plate bath," each separate plate being lifted by a crane into a great tank containing acid, and then placed in a bath of boiling water by which all the acid is washed off thoroughly. After a plate has thus been freed from rust and dirt it is carefully oiled and then painted with lead paint. The next step is to shear the plates and angle bars to the exact form required by means of enormous steam-operated shears, the blades of which are made of the hardest steel and move up and down slowly. The steel plates to be manipulated often weigh many hundred pounds, but they hang on a free arm of the shears that is capable of moving in all directions and is so easily operated that even the heaviest plates can be managed by three men, two of whom take hold of the outer ends of the plates, and push them in the direction indicated by the third man, who stands close to the shears. After the plates have been sheared their rough edges are planed down in a planing machine so that they will fit together properly. For this operation each plate is fastened on a kind of car moved by steam power over rails past the blade of the plane, which is made of the hardest steel, and each time it passes the sharp steel takes a shaving off the plate until it has been reduced to the right size. In order to fasten two plates on the ship's body they must be provided with holes that exactly register, so that they can be riveted together. The holes in one plate are transferred to the other by means of templets and then punched. The punching device used is similar to the shearing device, except that it is provided with removable punches of different dimensions instead of blades. The accuracy, ease and certainty with which these great power machines work is wonderful. Everything seems to be done so easily that one does not feel a proper respect for them until a thick plate of armor is shaped or perforated in an instant right before one's eyes; but woe to the arm that



A CRUISER IN PROCESS OF CONSTRUCTION—SHOWING TRANSVERSE FRAMES.

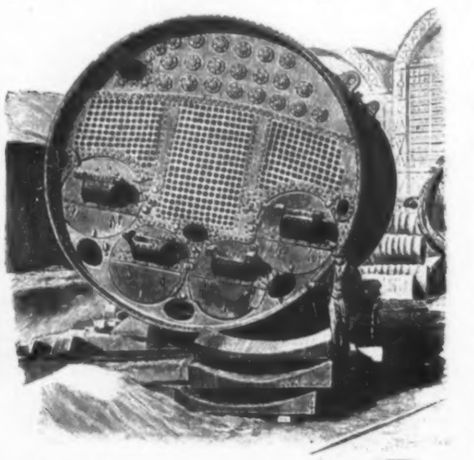


BRAZILIAN ARMORED VESSEL "24TH OF MAY" IN FLOATING DOCK—VIEW OF THE BOW.

HOW A SHIP IS BUILT.

is carelessly brought within their reach! It will be crushed or cut off in asecond.

Much depends on the proper joining of the plates; the rivet holes must register exactly, as otherwise the rivets would become weak and might easily break when the ship is tossed on a rough sea so that the frames are subjected to strain, and in this case separate plates might become detached, leaving the vessel in a most dangerous condition. After the plates and angle bars have been subjected to the baths, sheared, planed, punched and rolled, they are ready to be put in place, and the first requisite is to secure a proper slip from which the ship can easily be launched after it is built. The slip is a plane inclined toward the water with a floor of heavy planks, and on both sides a little farther apart than the width of the ship are high spars forming scaffoldings similar to those used in building a house. On the ground, in the middle of the slip, are the keel blocks resting on piles driven far into the ground. These blocks of oak are held in place by cramps and their upper edges form the curve for the keel which rests on them. The keels now generally used consist of two horizontal keel plates riveted together and corresponding to the form of the ship, and a vertical middle keel plate. These separate plates are firmly united by three sets of rivets and are further strengthened by angle bars. After the keel is laid the transverse frames are set on it. These frames, which extend from the keel to the upper deck, consist of several divisions; in mercantile vessels of two, and in war vessels of three divisions. The lowest division extends to the edge of the inner bottom and is strengthened by floor plates—strong plates of approximately triangular shape—which are provided with manholes; the second division of the frames extends to the armored deck, where there is one, or to the upper deck of a merchantman. In our illustration entitled "A Cruiser in Process of Construction," these frames are shown completed to the armor deck. The third division of the frames rests on the armor deck and extends to the upper deck. The greatest care is given to the preparation of these frames and to their perfect adjustment. In the first place, moulds are made of long, narrow strips of steel, from the lines of the mould loft floor, and secured by cramps to a "bending slab," and the angle bars are placed on these moulds while red hot and bent to their exact form. The frames are heated throughout their entire length in a reheating furnace that is about 66 feet long, and then, after



BOILER OF "KAISER WILHELM DER GROSSE."

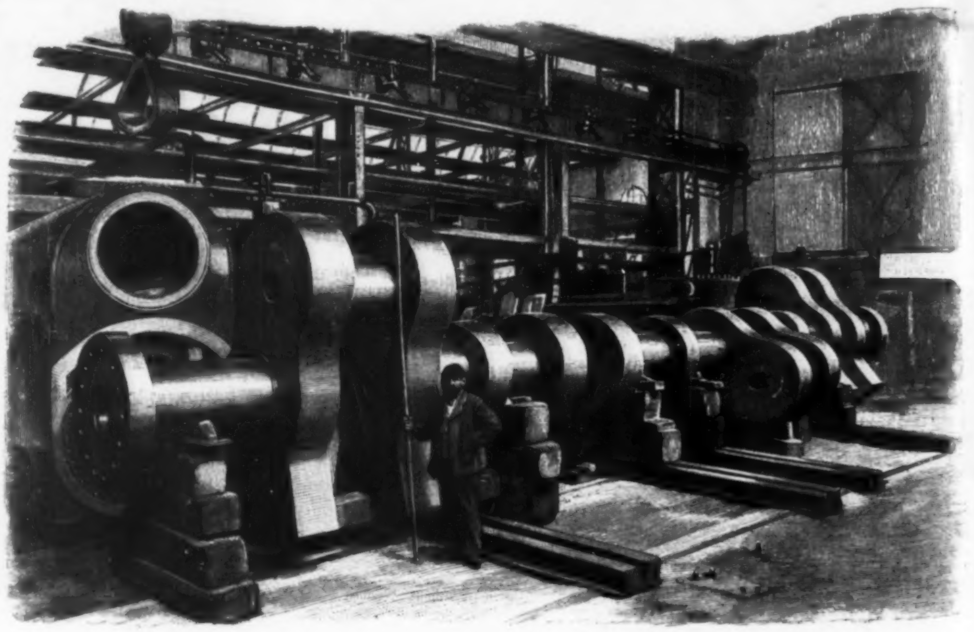
having been punched, they are riveted in place. In order that their edges may form a smooth curve, wooden beams of the right curve are screwed to their outer sides at certain intervals. When a ship has been so far completed it looks like the skeleton of a gigantic fish and could scarcely be recognized by one not versed in such matters.

Next, the inner bottom and longitudinal frames are put in place. The former is watertight and tends, as before observed, to increase flotation of the ship; and the latter constitute a very important part of the framing. The inner bottom rests on the middle keel plate and the floor plates to which it is secured by angle bars; it is watertight and has only a few manholes, oval holes closed by watertight screw covers and each large enough to allow a man to pass through for the purpose of making repairs or of cleaning the fresh water tanks, which are located in the double bottom. The longitudinal frames, which consist of strong steel plates, run through the double bottom and are strongly riveted together and to the inner and outer bottoms. This longitudinal system is no longer employed in building German mercantile vessels, although it was used to advantage in the "Great Eastern." The German Lloyds can be thanked for the introduction of these important parts of the frame. In the early eighties they tested, theoretically, the frames of most of the large German steamers, and found that the longitudinal frames did not meet the requirements as to strength in a single vessel—they were too light; while the transverse frames satisfied all demands made on them, and in practice they certainly have not shown any marked defects.

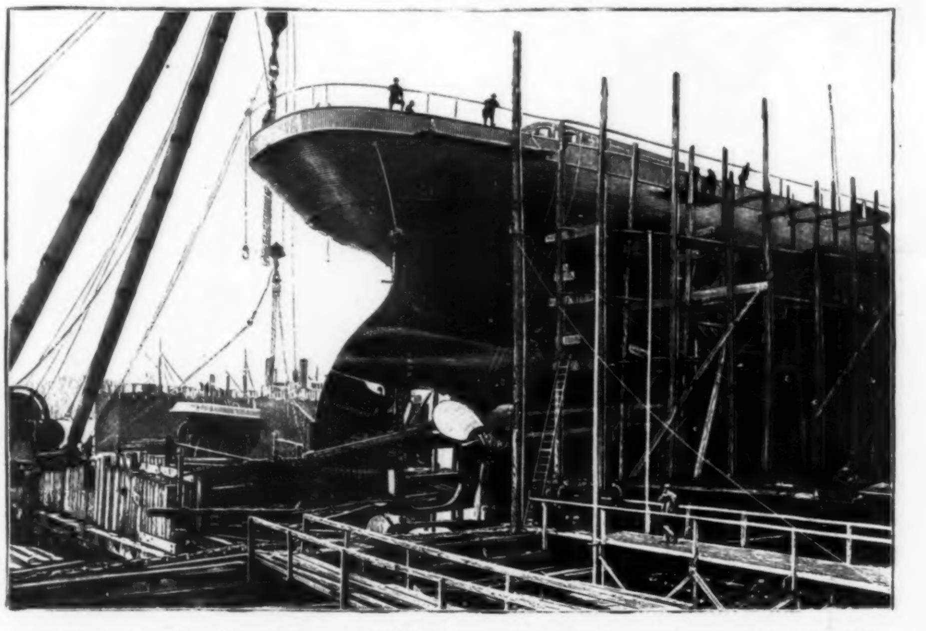
After the keel, transverse frames, longitudinal frames and double bottom are in place the watertight bulkheads are built. The transverse bulkheads are transverse partitions which extend from the upper deck to the inner bottom and entirely across the ship, from port to starboard; they are made of the largest plates possible and are stiffened by vertical angle bars. Longitudinal bulkheads are not much used in modern vessels, but on ships with twin screws there is one longitudinal bulkhead in the center which separates the two engines.

The use of these longitudinal bulkheads has been abandoned, because a long longitudinal compartment fills quickly in case of a leak, and this additional weight on one side of the vessel would cause it to list so that there would be great danger of its capsizing.

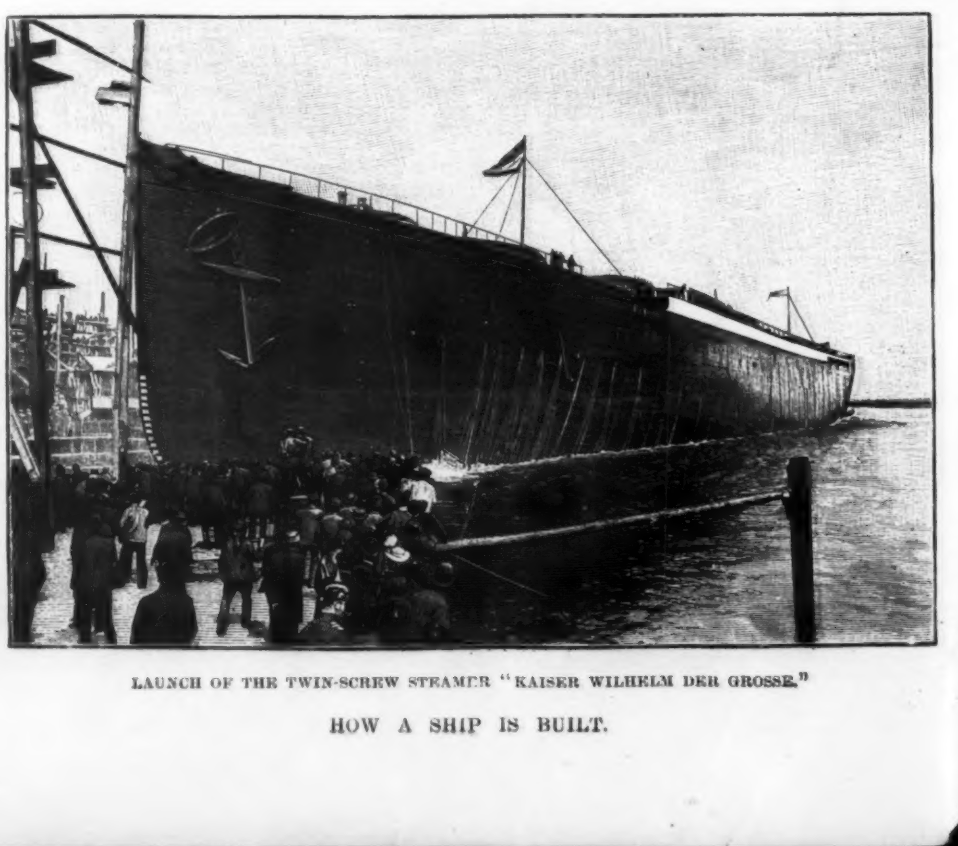
The next step in the construction of the ship is the building of the decks, which also consist of steel plates, and are provided at the sides with stringer plates, that help to strengthen the longitudinal frames. The orlop and lower decks consist only of steel plates, no covering of any kind being placed over them. The plates of the middle deck are covered with linoleum, and those of the bridge and promenade decks with planks of American pitch pine or yellow pine or other wood that withstands the weather. The shade deck consists entirely of wood; the planks are narrow and closely fitted, the seams being calked with oakum and filled in with marine glue to prevent moisture from penetrating through the floors. These floors make the ship look very trim, especially when they are made of teakwood, and are kept perfectly clean.



CRANK SHAFT OF THE "KAISER WILHELM DER GROSSE" IN MOUNTING ROOM.



TWIN-SCREW STEAMER "KAISER WILHELM DER GROSSE" BEFORE LAUNCHING—VIEW OF STERN.

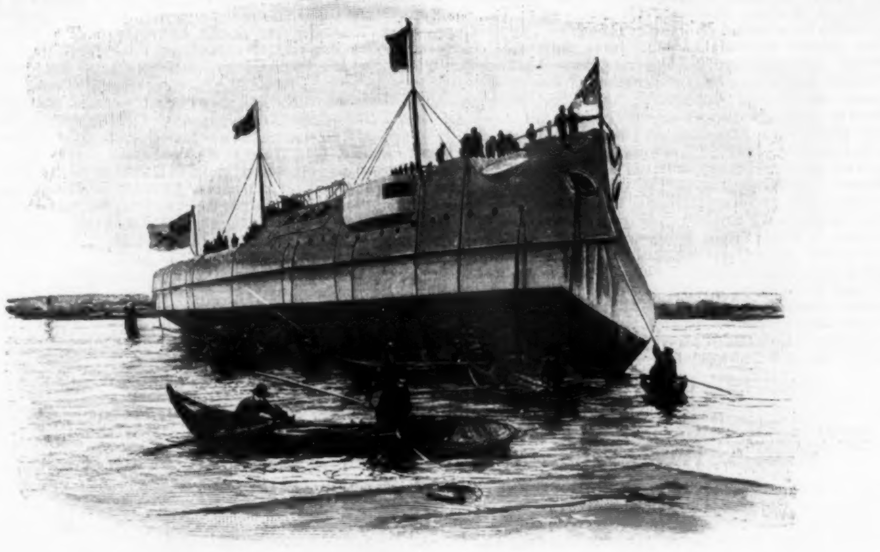


LAUNCH OF THE TWIN-SCREW STEAMER "KAISER WILHELM DER GROSSE."

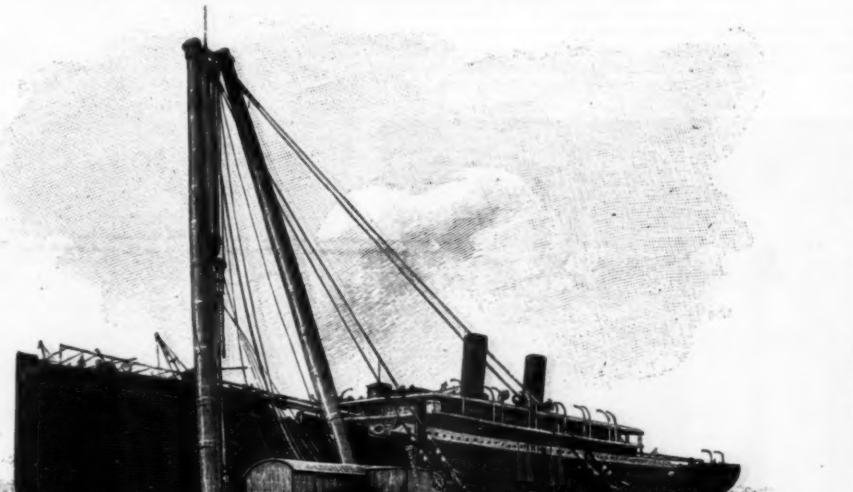
HOW A SHIP IS BUILT.

Before putting the outer plating on the hull, two difficult pieces of work have to be attended to. We refer to the setting of the stem and stern post. These are made of cast steel or bronze, and the stem generally consists only of one piece, but the stern post, with the rudder post, to which the rudder is attached, is built up of several pieces—the number varying according to the size of the post—which are bolted together before the post is set. It often happens that two sections do not fit perfectly, on account of the warping of the castings, and then they have to be reheated and straightened. For this purpose a sort of furnace is built of fire brick around the piece to be manipulated, and a strong fire is kept up for days, until the steel is red hot and malleable. When the parts fit closely, they are screwed together, and the post is carried to the ship on a specially built car, and then lifted into place by a crane.

Now only the outer plating is needed to make the vessel ready for launching, and possibly the lower strakes have already been put on in connection with the bulkheads. The plates are generally arranged according to the clencher system, that is, in alternate raised and sunken strakes, so that the edges of the plates of one strake lie firmly on the frame and those of the plates directly above and below lap over those in the first strake, the butts of the plates in each strake being united by butt straps laid on the inside. As the edges of the separate strakes must fit exactly and the plates must be cut specially, a small wooden model of the ship's body is made and the strakes of plates are laid out on it; the breadth of the strakes is then measured off with strips of paper and transferred to flat paper, and the steel plates are cut and riveted on according to the model thus made. After the plates are riveted on, except those of the watertight compartments, the edges of the holes are hammered down with a blunt chisel, so that all little irregularities, such as always occur in riveting, are filled out.



THE "BRANDENBURG" AFTER LAUNCHING AT THE VULCAN WORKS.



FLOATING CRANE AND THE MAIL STEAMER "FRIEDRICH DER GROSSE."

THE "HERTHA" ON THE DAY OF THE LAUNCH—VIEW OF THE STERN.

HOW A SHIP IS BUILT.

Now the hull is complete, and when it has been painted the ship will be ready for launching.

In warships the outside plating is often covered, as far as the water line, with planks of teak or olive wood, and this, in turn, is covered with copper plates; but as mercantile vessels do not need to be so carefully protected, they are simply painted with a patent paint which prevents the adhesion of algæ and barnacles. The uncoppered vessels of the German navy, when stationed near home, are painted a simple gray, because that is least noticeable at sea, but war vessels intended for foreign service are painted white above the water line as a protection from the intense heat of the tropical sun. German merchantmen are generally painted bright red below the water line and white or black above.

In narrow rivers, where there is not a great deal of room for launching, the screws are mounted before the vessel is launched, in order that they may check its motion after it enters the water. The ways on which the vessel runs out are covered with grease, soft soap and tallow, and the runners which slide on these ways are made of strong beams shaped to exactly fit the ship's bottom, to which they are secured by strong ropes; the runners are also fastened to the ways by ropes. When the latter are cut, the ship, with the runners on which it rests, necessarily obeys the laws of gravity and slides out into the water, but as there is great danger that this movement may become too swift and powerful, care is taken to limit it by various devices, one of which is a brake keel that is fastened to the vessel by means of long chains that are coiled up on the bank, so that as the vessel slides out it is obliged not only to uncoil the chains, but also to drag the brake keel between two enormously thick beams which are fastened such a distance apart that the space between them is only as wide as the thin edge of the keel. The vessel moves with such tremendous force that it frequently happens that the keel or one or both of the beams is broken. Besides this, two heavy anchors are hung by chains at the bow of the vessel so as to fall the instant the ship strikes the water. The chains used in launching a ship are, of course, extremely heavy; the separate links are as thick as a man's arm and have an average weight of 150 pounds; and yet these great chains often break and the ends whizz through the air, demolishing everything they encounter. Seafaring people consider a good launching a fine omen for the future of the vessel. After the ship has been christened and the ropes cut, it slides majestically into its element, throwing the water high when the keel strikes it. The monster stands high out of the water and is quite helpless, but it is immediately surrounded by numerous tugs that bring it back to the dock where it is secured while being completed. It is no longer Ship No. so-and-so; it has a name, and a flag flies from its stern.

Now the great floating crane begins its task of lifting the heavier fittings into the vessel. The boilers are the heaviest load it has to carry, for the engines are shipped in separate parts; these, like the boilers, were prepared while the hull was being built, and were set up in a mounting room, but were taken apart again before being sent to the vessel. The boilers of the "Kaiser Wilhelm der Grosse" weigh 94 tons each and are 16 feet 4 inches in diameter; there are twelve double-end and two single-end boilers on this ship. The enormous funnels are also lifted with great ease by the crane. One does not realize their size when seen on a completed ship, but those on the vessel just referred to are 42 feet 7 inches high and 13 feet in diameter.

When the boilers are in place and the engines are mounted, with the propeller shafts and steam pipes, they are tested, diagrams taken, etc., while the vessel is tied up to the wharf, and any irregularities are corrected. It is, of course, most important that every precaution should be taken to reduce the amount of coal required, and the modern triple and quadruple expansion engines, with high, medium and low pressure cylinders, consume only about one-sixth the amount of coal required for the old single, low pressure engines. The large marine engines are generally of the vertical type, and are balanced according to the Schlick system to prevent vibration.

Fitting out a large transatlantic steamer like the "Kaiser Wilhelm der Grosse" requires from four to six months, although more than a thousand men are often employed day and night in the work. When all have completed their tasks, except perhaps a few painters, cabinet makers and carpet layers, who may be at work in the cabins and saloons, a tug tows the vessel out to deep water and a trial trip is made with representatives of the owners and of the constructors on board. A mile is staked off on the shore, and the vessel is obliged to run over this course at different rates of speed, and diagrams are taken, and if the H. P., the speed, the quantity of coal consumed and the ease with which the vessel can be managed meet the requirements, it is accepted by those who ordered its construction. Generally the terms of the contract include an agreement that a premium shall be paid for anything above the determined rate of speed, or a penalty for anything less.

After the trial trip the ship goes back to the dock to receive a supply of coal and provisions and then is ready for a voyage. One who has never lived in a seaport town can have little idea of the bustle and life given to the whole neighborhood by the building of a great vessel, supplying as it does a means of livelihood to many families.—Ueber Land und Meer.

SPANISH NAVAL EDUCATION.

By HENRY HALE.

THE personnel of the Spanish naval officers and the methods by which they are educated are, perhaps, as little known in Europe as in our own country. Although Spain has what might be termed an elaborate system of naval education, such a period has lapsed since she has been engaged in a war of any magnitude that the actual ability of her navy is an unknown quantity, although the near future may demonstrate it very clearly to America and the Great Powers. It is generally admitted that the insurrection in Cuba, while long continued, has merely shown the inability of her military forces and what is generally believed to be corruption among the officers in command on the island. The naval work has been merely confined to a few engagements of gunboats and filibusters, and has been really of no consequence.

The reputation achieved by the Spanish in the days of the Armada and in the conflicts which distinguished the early part of the present century is familiar to every reader of history; and it is the opinion of British and other naval officers that to-day Spain's power lies principally in her naval representatives. Political influence however has prevailed to a large extent in the army and navy as well as other departments of the government, but it has not been as widespread in the latter branch of the service as in the other; and the Spanish naval officer, while he has not received the thorough training requisite for a commission in our own country or Great Britain, is still fairly proficient, while so far as courage and natural advantages are concerned, he is perhaps equal to any of his rank. At the time the Armada was afloat, Spanish sailors had no superiors the world over, and their skill in naval tactics at that time was remarkable. The city of Cartagena was formerly one of the principal educational centers, but later Ferrol, near the northwestern coast, became the site of this branch. The young Spaniard receives his primary education still at Ferrol, but with the exception of the engineering school, the higher institutions are at Cadiz. The graduates of the navy complete their course at the academies of San Carlo and San Fernandina, where are located also smaller schools of gunnery practice and torpedo practice, which form what would be called in this country post-graduate courses.

The Spanish naval cadet is selected from the upper classes. Sons of officers in service or retired constitute the majority, although any one who is in proper physical condition, a Roman Catholic and a Spanish subject, is supposed to be eligible. Outside the sons of officers, however, one finds only the children of professional men in the list, occasionally the family of a tradesman being represented. This is far different from the United States, where the members of the Annapolis Naval Academy come from all walks of life. As the navy is very popular with the people, there is a great demand for entrance, and the beginning of each school year finds far more applicants than can be accommodated at the training school. One reason is that the army and navy circles are as popular as in the United States from a social standpoint, and officers are everywhere received with the utmost cordiality at festivities and other society events. It is a very pleasing life to be stationed at Madrid, Cadiz, or any of the larger cities, all of which have a numerous garrison, while all of the important Spanish harbors in time of peace contain one or more warships, the officers being allowed ample time for recreation on shore. Another reason is that the number of physicians and legal practitioners is extremely small in Spain, and the opening for young men in this respect is very limited. The question of caste, such an important part of the social system, deters the young Spaniard from engaging in trade of any kind unless he is of the mercantile class. Even then many endeavor to avoid an occupation which they consider obnoxious, by entering the service. As the pay of the officers is fairly good, and they are, of course, provided for at the expense of the government, life on board ship and in a garrison has many charms in times of peace. Consequently, it is not strange that the officers, as already intimated, represent the highest class of the Spanish people, and number not a few scions of nobility in their ranks.

The system of instruction should result in a very high standard of ability in the navy. Beginning with the training school, which is on board an old warship at Ferrol, the students are taught all of the essential studies which would enable them to command a vessel and become experts in the most strategic tactics of modern naval warfare. The primary instruction, which lasts from two and a half to three years, includes hydrography, natural philosophy, mathematics, fencing, drawing, gymnastics, and the study of English or French at their option. Graduates in these studies enter the engineering school or the academies at Cadiz, the former students taking special courses of mechanics, dynamics, etc., while the others receive their diplomas after completing a course in higher mathematics, navigation, naval maneuvering and administration, artillery tactics, and, as already stated, torpedo practice. The finishing touches, as they may be termed, are put on by a cruise at sea, varying from six months to a year, after which holders of diplomas are given positions as lieutenant or some higher office.

The instruction in the various schools is in charge of naval officers, appointed through the Minister of Marine; most of them rank as lieutenants in the service, although the training school at Ferrol, as well as the academy of San Fernandino, is in charge of retired commanders who have sole charge of the curriculum and outline the educational policy. What is known as the Post Captain is the executive head of each school, who carries out this policy, the instructors being under his orders. As at Annapolis and West Point the cadets elect their own officers, having a commandant and subordinates for drill purposes. San Carlo is essentially the artillery school, in charge of a colonel of artillery and a board of officers representing both branches of the service; for the graduates of San Carlo man the ordnance both on the warships and in the land fortifications. As may be imagined, the engineer students are taught special branches, and the course here is widely different from the methods pursued in the other institutions. Contrary to our own plan, Spain has a special system for the education of marine officers. The standing of these troops is considered the lowest in the service, and the pupils are made up of non-commissioned military officers and naval cadets who have been unsuccessful in the training school or have been obliged to leave the navy for some other reason. The age of admission to the training school is from thirteen to eighteen years, to the Cadiz academies from eighteen to twenty-six years, and to the engineering school from sixteen to twenty-one years.

What naval officers consider the weak point in the Spanish method of instruction is the fact that it is not necessary to graduate from the training school to enter San Carlo or San Fernandino. The applicant who passes a certain examination and who is a Roman Catholic in religion can enter either of the academies. This allows candidates who have influence easily to obtain comparatively high positions in the service, without beginning at the bottom of the ladder, so to speak; and it is a well known fact that the examinations in many instances are made easy in order to secure positions for this one or that one who has an influential relative or friend at court. The candidate may be well qualified and may develop into a competent officer; but the laxity of the system frequently admits persons not properly fitted for responsible positions. The rigidly maintained standing, for which the naval service in the United States, Great Britain, Germany and other countries are noted, is lacking here. The first years of the cadet's life are the hardest, and though he may have obtained his entrance to the training ship partly through influence, it must be said to the credit of the instructors at Ferrol that they are considered more impartial than in any of the other institutions except the artillery schools.—The Independent.

NEW DEVICE FOR DRAWING LIQUIDS FROM BOTTLES AND CANS.

M. G. LIPPMANN recently presented to the Academy of Sciences an interesting apparatus devised by Baron Robert Personne de Sennevoy, and which solves the following problem: Being given a hermetically closed vessel filled with liquid, to extract any portion of the latter without allowing the external air to enter.

It is clear that a solution of this problem leads at once to two practical results. In the first place, in consequence of its being impossible for the air to enter, the most alterable liquids can be kept on tap, and volatile ones, such as gasoline, benzine, alcohol, ether, etc., can be protected against accidental inflammation.

FIG. 1.—BOTTLES PROVIDED WITH HERMETIC APPARATUS FOR DRAWING LIQUIDS.

The reservoir behaves always as if it were full, and on this account its application may be extended to the preservation of photographic reagents, which the air rapidly spoils. Afterward and necessarily, it is evident that this sort of receptacle leads to the "inviolable bottle;" for it is impossible to extract the whole or any part of the liquid unless the vessel or the seals guaranteeing genuineness are broken, or to introduce into the receptacle a single drop of a foreign liquid.

In principle, the entire system is based upon the use of a hermetical receptacle provided with a small pump. The liquid can be extracted only by causing it to traverse the pump chamber, during which a vacuum is formed behind it. It requires but a few strokes of the pump to cause the liquid to make its escape through the external cock. The piston of the pump becomes filled during its up stroke, and, during the down one, an elastic valve applies itself to the extremity and prevents the outflow of the liquid. The latter is extracted at every stroke of the piston without the receptacle ever being unstopped while it is being emptied.

The arrangements of the mechanism vary according to the purpose for which the apparatus is to be used. In Fig. 1, to the left, is shown one of the most practical types, in that it may be used with a bottle of any shape whatever. The cylinder, C, forms a tight joint with the neck of the bottle, R, to the bottom of which it extends and with the interior of which it communicates through the orifice, O, closed by a valve, S, of which the density is slightly greater than that of the liquid. The precaution is taken to have the relative densities such for the following reason: The piston, P P, provided with elastic valves, S S, does not act as an aspirator when it moves in the cylinder, since no atmospheric pressure exists in the interior of the receptacle, which we shall suppose perfectly full. Upon moving from the point, O, closed by the valve, S, the piston simply permits the mass of liquid to enter the cylinder through its own weight, by virtue of the law of communicating vessels. When the piston is pushed toward the bottom of the cylinder, the admission valve, S, serving as a bearing point, the fluid, compressed between it and the piston valve, obliges the latter to give passage thereto in order that it may afterward make its exit through the external cock. The piston therefore acts in reality only as a compressor.

We represent also in the same figure an arrangement called an expansion compressor. This is a device which in a manner forms the counterpart of the one just described. Instead of allowing the fluid to pass directly at the surrounding pressure, it stores it under pressure in a receiver, D, at the top of the pump. This receiver is fitted through a tight joint to the eduction orifice of the hermetical apparatus and contains either air or some gas or other which is at first at the pressure of the atmosphere. The entrance into the receiver of the liquid that is extracted at every stroke of the piston compresses the air above it. A nozzle provided with a cock allows the liquid thus stored up under pressure to be drawn off at will and in any definite quantity, since the receiver may be a graduated tube in which the level of the liquid rises parallel with the graduation consulted, as slowly as it pleases the operator.

As the receiver represented in the apparatus shown in Fig. 1 to the left is provided with an atomizer, it is easy to see how many applications await the expansion compressor, which may be substituted to advantage for rubber ball vaporizers, especially in the form shown to the right of the figure, which represents a bottle surmounted by an elegant glass fountain provided with a cock that permits of distributing perfumes, medicines, etc., in the form of a spray.

Fig. 2 represents another interesting application of Baron de Sennevoy's invention. Upon a kerosene can converted into a safety receptacle, through the addition of one of the apparatus sealed at C C, is screwed what is called an "Egide" lamp, which burns directly any quality of kerosene. A simple motion of the pump permits of maintaining a high level in the reservoir of the lamp, thus assuring a constant intensity of light and preventing the charring of the wick. A five-quart can affords about one hundred hours of light with a large burner. After the can is empty, the lamp, the bottom of which is provided with a valve that prevents the escape of the kerosene, is screwed to another can, which may be obtained sealed in exchange for the empty one.

FIG. 2.—APPLICATION OF THE APPARATUS TO KEROSENE CANS.

Amateur photographers will be able to derive benefit from the use of this new system. It is well known that the majority of developers rapidly lose their essential properties in the air. It is necessary to prepare them just before using them or else decant them into small bottles, which are completely filled in order to prevent contact with the air. It is unnecessary to say that a developer inclosed in a vessel provided with one of the devices here described will be preserved against the slightest alteration.

For the accompanying illustrations and the above particulars we are indebted to La Nature.

A remarkable building is now in course of erection on a plot of ground on Carr's Lane, Birmingham, which for a quarter of a century has remained unoccupied. Three feet beneath the surface of the ground there runs a tunnel of the Great Western Railway, and as the tunnel could not with safety bear more weight than it now does, all plans for building on the ground have been condemned by the city surveyor and the railway engineer in consultation. By an ingenious device, however, an architect has now prepared plans whereby a three-story building is to be erected on the site. Twenty-five feet will have to project over the tunnel, and as no weight is to rest on the tunnel, this has to be erected on huge cantilevers. These cantilevers, six in number, run to a depth of 6 feet, and are estimated to carry weights varying from 100 to 400 tons. The "A" cantilever supports the greatest weight, estimated at 400 tons, and is calculated to support a strain of 875 tons. The "A1" cantilever will support 375 tons of the building, while only 19 feet of it under the building will rest upon a solid foundation. To add to the safety, from this hangs a mass of concrete, 16 feet across by 15 feet high, and weighing 160 tons, suspended by steel bars 22 feet long. The whole thing resembles the weighing of a carcass on a butcher's steelyard. The cantilever acts as the steelyard, the warehouses and the shops are supported at the long ends and the great weight of concrete hangs from the short one, acting as a counterpoise, while the cantilever rests upon a bed of concrete.—The Architect.

COMPRESSED AIR MACHINERY.

THE application of compressed air in modern manufacturing plants has probably met with more marked success than any other labor saving device which has been lately introduced. Its numerous uses, such as hoisting, chipping, drilling, riveting, painting, sand blasts, small motors, etc., make it of great value in any large industrial establishment. One of the first modern applications of compressed air was in the foundry, where direct-acting hoists were used. From the foundry it rapidly spread to other departments, until now in a modern equipped plant it is used from cellar to garret, and new uses are constantly being found. The latest designed pneumatic hoist will draw the pattern from the mould as well as, or better than, the most careful moulder; yet the same machine may be used for lifting the heaviest weights. Pneumatic chipping hammers have been perfected which will cut out of a solid forging a continuous chip ¾ inch wide and ¼ inch thick, with great rapidity. The smaller chipping hammers can be used for the finest kind of stone lettering, die work, etc. Compressed air has shown itself of great value for use in portable drilling and riveting machines, which are now used in all classes of boiler and ship work; a drilling machine being used for reaming, also tapping and driving stay bolts.

These few uses for compressed air have created a demand for small yet economical air compressors. We illustrate herewith several machines which are especially designed for manufacturing plants and other places where an intermittent supply of air is required. The sectional view shows the general construction of the 6 and 8 inch machines. Both the cylinders and heads are water jacketed. The valve case and the governing mechanism are one of the principal points of interest in the compressor. This case is entirely separate from the machine; the valves and valve seats are easily removed, to replace any of the valves, it being only necessary to unscrew the cap over the valve chamber. The intake to the compressor is so arranged that a conducting pipe can be added so as to draw air from a cool, clean spot outside of the engine room or factory. The governor is so arranged on these compressors that all pumping action is stopped as soon as the air pressure in the reservoir reaches the desired maximum.

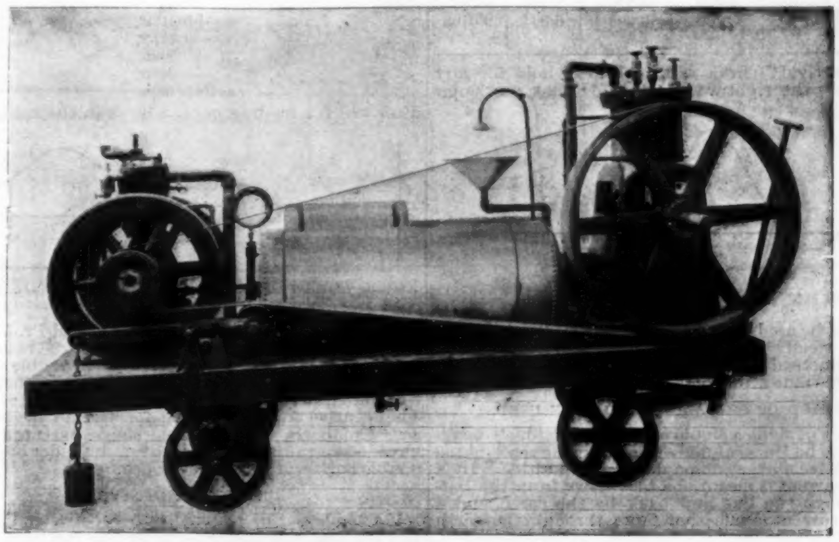
In older style machines the custom has been to provide the air receiver with a common safety valve, which releases the excess of air, at a total loss of all the energy expended for compressing during the releasing period.

We also show photogravure of one of the larger sizes of compressors which is built compound, with low pressure cylinder 13 inches in diameter, high pressure cylinder 8 inches in diameter, both with 12 inch stroke. The design of this compound machine is slightly different from either of the smaller sizes, the driving pulleys being placed between the two cylinders. In the compound machine the valves are placed in the cylinder heads, so as to reduce the clearance to a minimum. This machine is provided with brass intercooler, and also has the automatic governor above referred to.

The main shafts of these compressors run in self-oiling boxes, provided with chain oilers. All the parts are fitted with the most improved automatic oiling devices. The bearings are of extra large size, so as to provide against undue wear. By driving these compressors from the main shop engine, much greater fuel economy is obtained than if a small slow speed independent steam cylinder were used.

We also illustrate a complete portable gasoline engine and compressor mounted on wheels, which has been found of value in outdoor erecting work.

These compressors are built by Curtis & Company Manufacturing Company, of St. Louis, Mo., to whom we are indebted for our engravings.



PORTABLE COMPRESSING PLANT.

BLINDNESS FROM THE ELECTRIC ARC.*

By Prof. ARTHUR J. ROWLAND.

THE danger to one's sight from the light of an electric arc, no matter whether produced for a useful purpose or the result of some chance short circuit, should be clearly understood by every one. This is especially true in view of the many uses of electric arcs, besides those so familiar in the common 1200 and 2000 candle power arc lamps.

If one's line of vision takes in such an arc as that in the ordinary arc lamp, or that due to an accidental short circuit, or one at the break of a large current at high potential, the eyes suffer a sort of paralysis, and on looking away one sees as through a fog. This effect soon passes away, and at worst requires a sojourn of a day or two in a dark room to produce a cure.

With arcs taking large currents, and especially if one electrode is metal, the effects are quite different and much more serious. At night one notices the intense brilliance and is on his guard. In daylight the contrast is not so great, and so one is more likely to suffer because of lack of care. After working with such arcs the eye does not immediately feel the effect, but after a time, perhaps hours afterward, a slight scratching is felt in the eye, as though there were some fine dust or cinders there. As time goes on this is followed by a feeling of dryness on the eyeball, accompanied by a very profuse shedding of tears, and all the symptoms of a heavy cold in the head are felt. If the attack is a bad one, the pain becomes a very intense aching and may be accompanied by a twitching of the eyelids. In these worse attacks the afflicted one can bear no light on the eyeball, and if the eyes are opened, finds he is blinded.

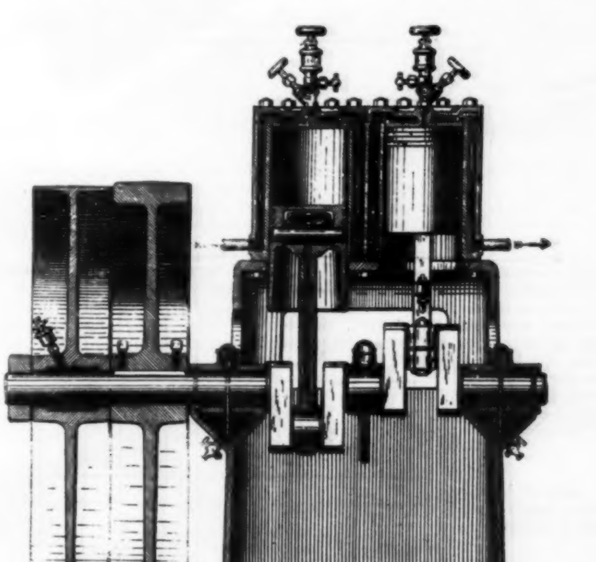
In case of slight attack a simple eyewash is all that is necessary for a cure. Use one made of six grains of borax in a fluid ounce of infusion of sassafras pith, or one of ten grains of boric acid in an ounce of camphor water. I can vouch for the first and have almost equal confidence in the second. In a very bad case a physician will apply cocaine, that local anæsthetic so commonly used in the eye. No one but a physician should do this.

After a few hours the pain passes away, and by keeping in a darkened room and then wearing smoked glasses for a couple of days, the eye wash being kept in use, all ill effects pass away, leaving the patient with a firm resolve to avoid further experience in this direction.

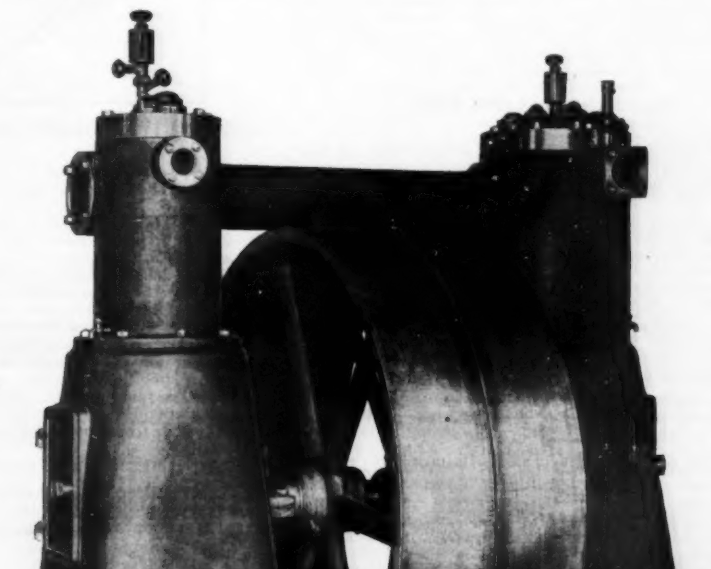
It is found that the effect of the arc has been to produce an external burn—like a sunburn—on the conjunctiva, or outer membrane covering the front of the eyeball. If one protects the eyes, this "sunburn" from the arc affects the skin; and results precisely like those after a day's outing at the seashore in midsummer are experienced.

In protecting the eyes against the burning power of such arcs it is not sufficient to wear such glasses as are made for those who adjust and repair common arc lights. Far too much of the light gets around them. It is necessary to use a mask covering the whole face. Even if one thinks to protect himself from all direct rays, by holding his hand before his eyes for example, there will still be likelihood of his suffering to some ex-

* American Electrician.



SECTIONAL VIEW OF 6-INCH AND 8-INCH COMPRESSORS.



13-INCH AND 8×12-INCH COMPOUND COMPRESSOR.

tent. In this way one who stops to look on may suffer from an eye trouble, the cause for which he has quite overlooked.

Drexel Institute. Philadelphia.

THE WORKING OF LONG SUBMARINE CABLES.*

By R. M. SAYERS and S. S. GRANT, Students I.E.E.

As all of us are doubtless aware, this institution was once the "Society of Telegraph Engineers and Electricians," but recently, with the exception, perhaps, of this session, papers have been so rarely read before the institution upon the subject of telegraphy that one is apt to lose sight of the fact. This is true more especially of the students' meetings, for, so far as the authors know, this is the first paper treating of submarine telegraphy which has been delivered in this room. Electric lighting and transmission of power have been so prominently brought into notice that submarine telegraphy has been forgotten by the large majority of electricians. This is, nevertheless, a branch

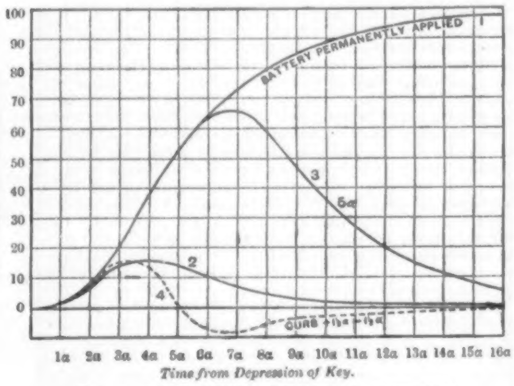


FIG. 1.—CURRENT ARRIVAL CURVES.

of electrical engineering of the highest importance, and large capital is involved; for, as Sir Henry Mance has pointed out in his presidential address, the money invested in submarine cables amounts to over 40,000,000 sterling, 75 per cent of which has been subscribed in Great Britain.

Before proceeding further we had better define a long submarine cable. By a long cable is meant one exceeding 400 or 500 nautical miles in length. There are about 130 such in existence. In the working of shorter cables than these we have not to deal to so large an extent with the difficulties of which we shall speak.

In a submarine cable we have a conductor offering a certain resistance to the passage of an electric current, as in a land telegraph line; but we also have something else which we only find in land lines to a far less extent, and that is the electrostatic capacity of the cable. It is this combination of distributed capacity

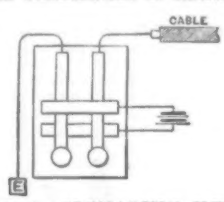


FIG. 2.—SIGNALING KEY.

and resistance which causes the retardation of the signals on long cables. When a current is sent through a cable every portion of it behaves as a condenser, and has to receive a certain charge. The effect of this is that the current at the further end of the cable does not reach the steady value of V/R given by Ohm's law until some time after the key at the sending end has been depressed. Curve 1, Fig. 1, is called the "arrival" curve, and shows the growth of the current at the receiving end. It was first shown by Lord Kelvin, then Prof. Thomson, to the Royal Society in 1855. The equation to the curve was deduced by him from the equations given by Fourier, for the passage of heat along a metallic bar. It is in the form of a series:

$$A = \frac{V}{rL}\left\{1 + 2\sum_{n=1}^{n=\infty} e^{-\frac{n^2\pi^2 t}{rkL^2}} \cos n\pi\right\}.$$

Where A = current; V = potential applied; r = re-

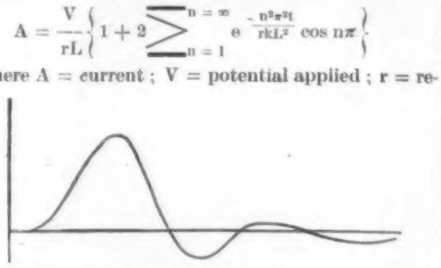


FIG. 3.—CURBED SIGNAL: $+3\alpha$, -3α, $+1\alpha$.

sistance per naut; k = capacity per naut; L = length of cable in nauts; t = time in seconds reckoned from instant of depressing key.

After depressing the key the current at the further end of the cable is infinitely small until after a time which we denote by

$$\alpha = \frac{krL^2}{\pi^2}\log_\varepsilon\left(\frac{4}{3}\right) = \frac{KR}{10^6} \times 0{\cdot}02915 \text{ second,}$$

where R = total resistance of cable in ohms and K = total capacity of cable in microfarads.

It may be seen that, other things being equal, α varies as the square of the length of the cable. Consequently, if we had two cables with identical conductors, insulation, etc., and similar in every respect, but one twice the length of the other, we should be able to send four words through the shorter cable for every one word through the longer.

Subjoined are a few values of α for different cables:

Cables.	Length in Nautical Miles.	k in Microfarads.	r in Ohms.	α in Seconds.
1865 Atlantic.....	1,896	0·3535	4·270	0·158
1873 "	1,876	0·353	3·167	0·115
1894 "	1,847	0·419	1·683	0·0701
Proposed Pacific.	3,650	0·420	2·250	0·368
Eng. and Norway	423	0·303	6·864	0·0108

The "arrival" curve will, of course, hold for any cable, only the right value of α for that particular

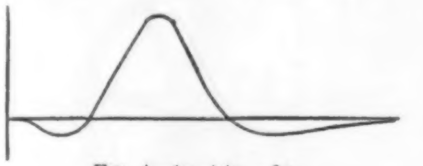


FIG. 4.—1α, $+4\alpha$, -2α.

cable must be used. The current does not, theoretically, reach its steady value till after an infinite time, but there is practically no difference between the curve and the steady value after 25α.

METHOD OF SIGNALING AND CODE USED.

The code of signals employed is Wheatstone's modification of the Morse alphabet; a dot being represented by a negative current and a dash by a positive. By a positive current is meant one that flows from the battery through the line and back by the earth, and a negative current is one that flows through the earth and back by the line.

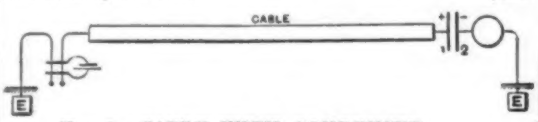


FIG. 5.—CABLE WITH CONDENSER.

The signaling key is shown in Fig. 2. It is an ordinary reversing key; on depressing the right hand key the positive terminal of the battery is connected to the cable and the negative terminal to earth, thus a positive current or dash is sent; by depressing the left hand key a negative current or dot. When both are raised, the cable is to earth.

The receiving instruments employed are the mirror galvanometer and the siphon recorder; the former by the motion of a spot of light shows in which direction the current is flowing, and the latter draws a record of these motions on a band of paper. These are the only instruments used on long lines, and the siphon recorder has now come into almost universal use. They

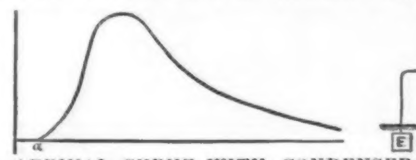


FIG. 6.—ARRIVAL CURVE WITH CONDENSER.

will both be fully described further on. We will now consider how these signals appear at the further end of a cable.

Curves 2 and 3, Fig. 1, show the growth of the current at the far end when the key is depressed for periods of α and 5α respectively and the cable then put to earth. It will be observed that a current continues to flow at the receiving end for some considerable time after the key has been raised. In fact, another signal could not be sent until a time of 6 or 7α had elapsed. If less time were taken, the signals would run into one another and confusion would result. This would give a very slow speed of signaling, as from 18 to 19 signals on an average form a word. For practical purposes we should not spend more than 1α over each signal. We shall endeavor to describe the methods by which this is effected.

CURBED SIGNALS.

If directly after sending a signal, a current in the reverse direction is sent through the cable, this reverse current clears out, so to speak, the residual or clinging

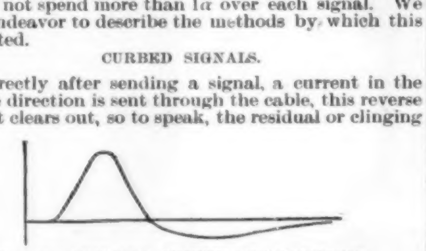


FIG. 7.—SIGNAL WITH CONDENSER.

current from the cable, which will discharge much more rapidly than if the signal were uncurbed. This is known as "curbing." The "arrival" curve returns more rapidly to the zero line, and if the curb is too great, crosses it. The dotted (curve 4, Fig. 1) shows such a curbed signal; it is obtained by sending a positive current for a time $1\frac{1}{2}\alpha$ and then an equal negative current for the same time, the cable then being put to earth. At this rate a signal lasts slightly over 3α. This signal of course would not be of any use for practice, it has merely been taken to show clearly the effect of curbing, as the actual signaling currents would scarcely be distinguishable on this scale. The greater the speed of signaling, the more nearly equal should be the duration of signaling and curbing currents; at lower speeds the curbing currents would be less and the signaling current more. In general a ratio of five signaling to four curbing is used.

It may be observed that, although the positive current in curve 4 lasts for $1\frac{1}{2}\alpha$, the maximum received current is of about the same value as that of an uncurbed signal lasting for only 1α; because of this, with curbed signals, a larger battery power (nearly double) is used than with uncurbed signals. The system of curbing with a single reverse current is known as single curb. When a succession of currents in opposite senses is employed, it is known as double curb. To make the curve return quickly exactly to the zero line an infinite number of alternations would have to be used; this, of course, is impossible. Varley used the following curb:

$$+0{\cdot}213\alpha,$$
$$-0{\cdot}247\alpha,$$
$$+0{\cdot}092\alpha,$$
$$-0{\cdot}048\alpha,$$
$$\text{earth } 0{\cdot}400\alpha,$$

after which a fresh signal can be sent, the cable being

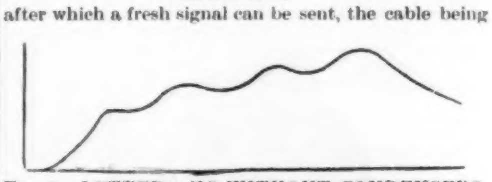


FIG. 8.—LETTER "H" WITHOUT CONDENSERS.

completely discharged. Lord Kelvin and Prof. Fleeming Jenkin devised an automatic curb transmitter which gave either a single curb or a double curb of three currents as required. Fig. 3 is a curb of positive for 3α, negative for 3α and positive for 1α. Fig. 4 is negative for 1α, positive for 4α and negative for 2α. Up to the present time single curb appears to have been the more successful, but doubtless the double curb will yet be developed.

USE OF CONDENSERS.

If a condenser be inserted either between the cable and the receiving instrument, or the receiving instru-

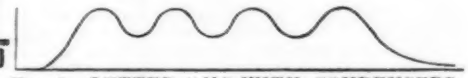


FIG. 9.—LETTER "H" WITH CONDENSERS.

ment and earth (Fig. 5), on depressing the key, plate 1 of the condenser receives a positive charge, and the inside of plate 2 an equal negative charge, and positive electricity is set free from the outside of plate 2, thus a momentary positive current or impulse flows through the receiving instrument to the earth; on raising the key the condenser will discharge and a momentary negative current flows through the instrument; this acts as a curb to the first current. Fig. 6 gives the shape of the arrival curve with a condenser in circuit. Fig. 7 is curve of current for a short contact of the key; compare this with the curbed signal in Fig. 1. Another important use of condensers is that the spot of light or siphon, as the case may be, is always kept near the middle or zero line, thus greatly facilitating the reading of signals (see Figs. 8 and 9). In practice

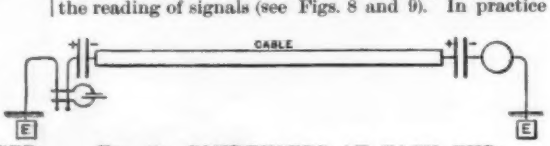


FIG. 10.—CONDENSERS AT EACH END.

two condensers are used, one at either end of the cable, as in Fig. 10. On depressing the key the charges on the plates are as shown, positive electricity being set free as before and flowing through the receiving instrument. This method is 33 per cent. more rapid than when working with only one condenser; it is now universally employed, as it has the additional advantage that the cable is completely isolated, and earth currents through the instruments are nearly, though not completely, prevented. This is because the current through a condenser depends upon the time rate of

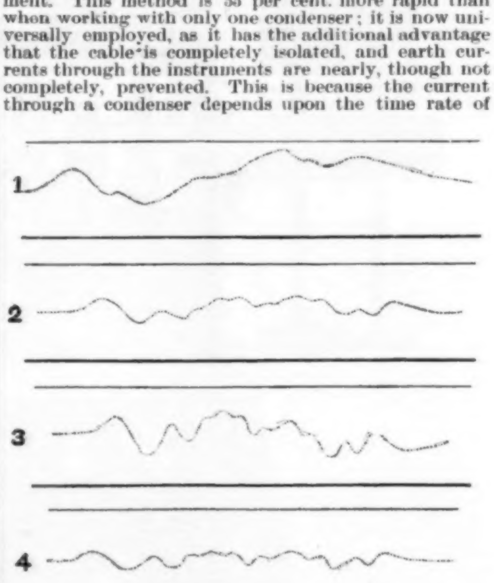


FIG. 11.

1. No condensers; no curb. 2. Condensers at both ends; no curb. 3. Curbed; no condensers. 4. Curbed; condensers at both ends.
72 letters per minute through artificial cable, equivalent to Pacific cable when laid. KR=12·06×10⁶. K=789. R=15,300ω. Sending condensers=80 mfds. Receiving condensers=40 mfds.

* Students' paper read before the Institution of Electrical Engineers.

change of the potential difference applied, and for two points on the earth's surface this is, in general, slow, and consequently the current flowing is so extremely small as not to affect the instruments. The above, of course, is not the case in magnetic storms, etc. The capacity of the condensers at either end is usually from $\frac{1}{5}$ to $\frac{1}{10}$ that of the cable. When only one condenser is used, it makes very little difference at which end of the cable it is placed. Figs. 11 and 12 are recorder slips of the word "imperial," showing effect of condensers and curbing.

SPEED OF SIGNALING.

In practice speed is not reckoned by so many α per

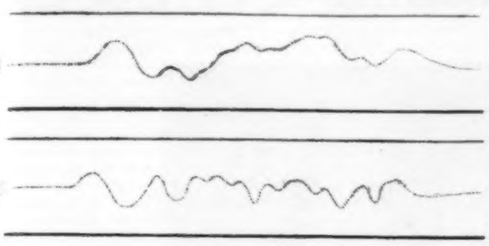


FIG. 12.

1. No curb; condenser at receiving end but not at sending end. 2. Curbed; condensers at receiving end but not at sending end.
70-72 letters per minute through artificial Pacific. KR=12·06×10⁶. Receiving condensers=40 mfds.

signal, but by what is called the "speed constant," thus:

Letters per minute × KR = speed constant = C,

or

$$v = \frac{C}{KR}$$

where v is speed in letters per minute.

Willoughby Smith gave the following formula for the speed of transmission in signals per minute:

$$v = \frac{1{,}297 \times d^2 \times \log \frac{D}{d} \times 10^5}{L^2}$$

where d = diameter of copper, D = diameter of gutta percha, L = length in nautical miles. The constant 1,297 will be different for other kinds of gutta percha

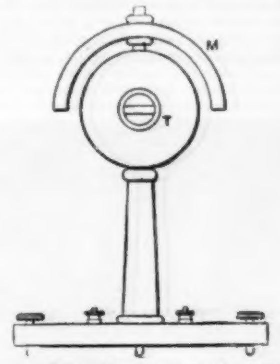


FIG. 13.—MIRROR GALVANOMETER.

than Willoughby Smith's. This formula gives 232 signals, or 58 letters per minute on the French Atlantic, or 1·05α per signal (KR = 8·4). Quicker speeds are obtained by modern methods.

RECEIVING INSTRUMENTS.

The mirror galvanometer, devised by Lord Kelvin, consists of a small magnet, made of a piece of steel

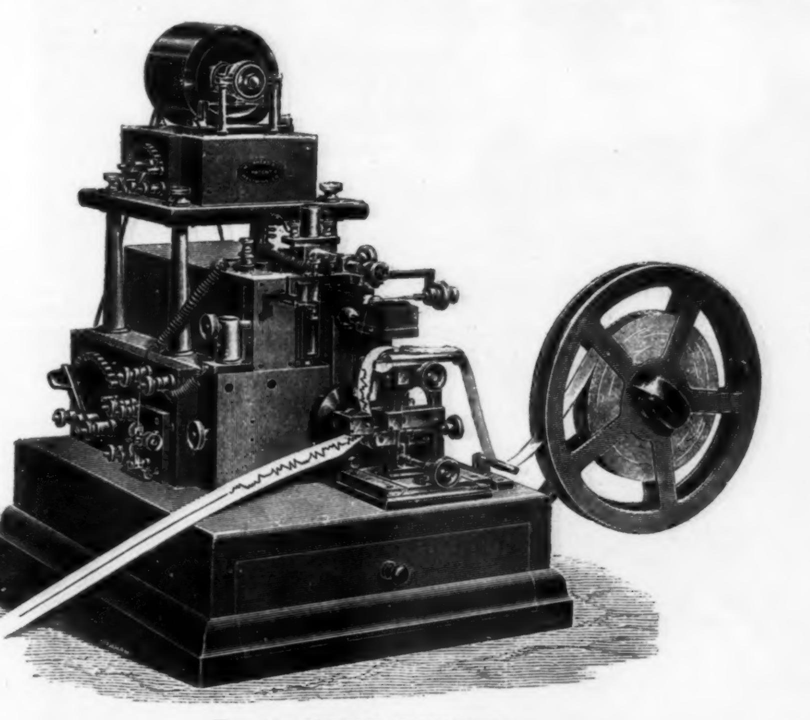


FIG. 14.—SIPHON RECORDER.

This constant is about 500 with uncurbed signals with condensers at either end, and about 720 when curbing is used, though a constant as high as 900 has been obtained experimentally with automatic curb transmitters. In the 1894 Atlantic a speed constant of 500 corresponds to 203 letters per minute, or about 30 words; this is about 1·14α per signal; with a constant

spring, supporting a concave mirror, which is suspended top and bottom by a short silk fiber inside a copper tube, T, Fig. 13. Round this tube, T, the coil is wound, the controlling magnet, M, being placed as shown. The instrument is made very dead beat, partly by means of the copper tube which damps the motion of the needle, and also, if necessary, by the tube (which

FIG. 15.—SUSPENSION PIECE.

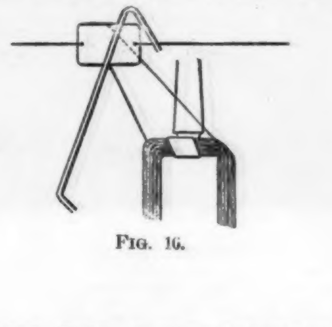


FIG. 16.

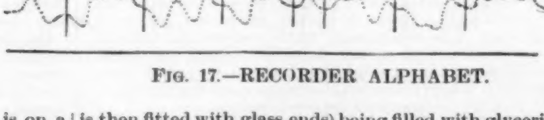


FIG. 17.—RECORDER ALPHABET.

of 720 we should get 0·791α per signal. This is on a basis of 3·7 signals (dots or dashes and spacing) per letter.

KR depends on the relative proportions of copper and gutta percha in the core of the cable. From this

is then fitted with glass ends) being filled with glycerine and water. A beam of light from a paraffin lamp is directed on the mirror, which reflects it back on to a screen; by the motion of this spot of light we are enabled to read the signals. It is interesting to note that mirrors were first applied to galvanometers for this purpose.

The next instrument is the siphon recorder, also invented by Lord Kelvin; there are two or three forms made by different makers: as an example we will describe the Muirhead instrument. This siphon recorder is constructed on the principle of the D'Arsonval galvanometer. It consists of a moving coil suspended between the poles of a strong permanent magnet by means of silk fibers. This coil controls the movements of a delicate glass siphon, one end of which dips in a vessel of ink and the other records the motions of the siphon on a moving band of paper. The friction between the end of the siphon and the paper would, however, greatly impede the motion, and to obviate this the siphon is kept in vibration by means of an electromagnet. It thus only touches the paper at intervals, tracing a series of dots. Fig. 14 shows the general arrangement of this instrument. A drawing of the coil and siphon and their suspension is shown separately (Fig. 15).

This portion of the instrument works up and down on a rack and pinion, so that the position of the coil between the poles can be adjusted. The coil (Fig. 15) is suspended by two silk fibers at the top and one at the bottom. For very long cables, where the speed of transmission is slow, only one fiber at the top is used. In the center of the coil is a fixed soft iron core. The siphon is attached to an aluminum carrier or "cradle," supported by a phosphor bronze wire, which is stretched across the bridge piece. One end is fixed to a milled head for adjustment of the tightness and the other to the armature of an electromagnet, the "vibrator," shown on the left. The intermittent current is supplied to the vibrator by an interrupter similar to an ordinary electric bell. The rate of vibration can be regulated by the position of a weight on the armature of the interrupter. Fig. 16 will more fully explain how the motion of the coil is communicated to the siphon. Formulæ for the best resistance of the coil have been given, but in practice it is usually about 500 ohms for long lines.

The permanent magnet is built up of a number of plates. The distance of the poles from the coils can be regulated by a screw adjustment. The paper strip is driven by a small electromotor worked by four tray cells. A motor is found more suitable than clockwork, not requiring winding up, and in hot countries clockwork is liable to clog. The coil is provided with two sets of slide shunts for sending and receiving. The first can be varied from ¼ ohm to 3 ohms, the second from 250 ohms to 6,000 ohms. The first is only used when a record of the sent message is required. The tightness of the suspension should be so adjusted that the periodic time of the coil corresponds with the speed of transmission.

The great advantage of siphon recorders is not that they are any quicker than mirror galvanometers, but that they give a permanent record, so that less skilled operators are required. Fig. 17 is part of the recorder alphabet, the Morse code is shown above it.

(To be continued.)

ALCOHOL IN RELATION TO MICROBIAL DISEASES.

THE effect of alcohol on the artificial production of immunity in animals in regard to rabies, tetanus and anthrax has been recently studied by Dr. Deléarde. It has been frequently observed that persons addicted to alcohol suffer as a rule far more severely from the effects of microbial infections than normal individuals; and not long ago, in 1896, Abbot, of Philadelphia, showed that pathogenic bacteria, incapable of killing healthy animals, were able to produce fatal results in animals intoxicated with alcohol. This was found to be the case with the B. coli communis, the staphylococcus, and the streptococcus. Deléarde has turned his attention to the effect produced by alcohol on the artificial prevention of disease in animals; and considering the great importance of the subject, it is to be regretted that his conclusions are drawn from so few experiments. It appears that a rabbit vaccinated against rabies, and then given considerable quantities of alcohol (introduced into the œsophagus by means of a tube) for several weeks, and subsequently inoculated with fresh rabid virus, did not succumb to rabies, while another rabbit treated similarly, only omitting the doses of alcohol, died of rabies. In this case the alcohol had apparently preserved the animal's immunity to rabies. On the other hand, a rabbit dosed with alcohol during the course of the anti-rabic inoculation obtained absolutely no immunity from rabies; while a rabbit, first of all intoxicated and then vaccinated, acquired immunity to rabies as long as the supply of alcohol was stopped as soon as the vaccinations were commenced. In the case of tetanus, however, if the anti-tetanic inoculations were succeeded by the administration of alcohol, the animal lost all its artificially acquired immunity to the disease, and invariably succumbed to tetanus infection. Again, if treated with alcohol during the vaccinations, it only acquired immunity to tetanus with difficulty, and if first of all intoxicated and then vaccinated, the animal obtained immunity as long as the supply of alcohol ceased when the vaccinations began. As regards anthrax, it is almost impossible, it appears, to protect animals from this disease if they are treated with alcohol during the vaccination period. On the other hand, animals first intoxicated and then vaccinated can acquire immunity provided, as in the other cases mentioned above, the alcohol is stopped as soon as the vaccinations are commenced, but they suffer considerably more during the process than animals which have received no alcohol. The experimental results obtained with rabies bear out the observations which have been made with regard to intemperate persons and the anti-rabic treatment in various Pasteur institutes, and a very striking instance of the ineffectuality of the treatment in such a case was recorded only this year. An habitual drunkard was bitten by a mad dog, as was also a child by the same dog; both underwent precisely the same anti-rabic treatment. The man during the whole time continued to drink to excess, and subsequently died of rabies, while the child remained perfectly well. In the case of the administration of antitoxins it would appear, therefore, highly desirable that at least during the vaccinations alcohol should be prohibited.—Nature.

THE JUBILEE OF HENRIK IBSEN.

On the twentieth of March of this year, Henrik Ibsen reached his seventieth birthday. In honor of this anniversary, entire Scandanavia was en fête, and the Swedes even fraternized with the Norwegians, for whom they have little love, while the men of letters, the official world and the people at large also acted in concert in the same mind. Notwithstanding the difference in the temperament of the peoples, it was something analogous to the latter birthdays of Victor Hugo. The following is the programme of the festivities, which began at Christiania and ended at Copenhagen: On the 20th of March, a gala representation of one of Ibsen's dramas; on the 21st, a banquet at which all the ministers and high dignitaries were present; on the 22d, a popular festival, and a gala representation at the Copenhagen Theater in the presence of Ibsen; and on the 24th, a banquet. Besides, on the 20th, the Politiken, the principal journal of Copenhagen, published a special number in which the greatest writers of the entire world expressed their complimentary opinions of the illustrious dramatic poet.

Having become familiar with glory, Henrik Ibsen, silent among the acclamations of enthusiasm, doubtless thought of the humble house at Skien where he was born, and of those childhood hours, so fully alive in his memory, which he had in mind when he wrote Solness. He thought, as then, of the little village church and of the high tower from which the keeper, fascinated by the gaze of a black dog, fell one day and had his head crushed. Then, in a comprehensive picture, he saw again the hard epochs of youth and maturity; and, loaded with honors, and sharing with Bjornstern Bjornsen the almost religious homage of his fellow citizens, he recalled the time at which he provoked their anger and indignation. Perhaps in the respectful crowd of admirers his eyes sought the university professor who in 1863, after the Comedy of Love, asserted that "the man who had written such a work merited a castigation rather than a traveling purse." He traveled, nevertheless, and, during his absence, dated from Rome, Dresden and Munich those pieces which conquered for him a universal and legitimate glory in his own country and the entire world.

The singular good fortune that his work met with in France is well known. The considerate admiration of a few persons gradually gained over, as usual, the innumerable herd of snobs, and, after the heroic days of the Théâtre-Libre, where Antoine gained applause for Les Revenants, came the triumphal soirées of the Cercle des Escholiers (La Dame de la Mer, December, 1892) and of L'Œuvre. The inadequacy of the actors and scenery and the weakness of certain translations did not arrest the public fanaticism, and the fashion was such that the worldly salons followed the example of the Théâtre-Libre in a few memorable representations.

So, despite the factitious and superficial character of certain imitative admiration, the influence of Ibsen upon French thought has been profound, and many French writers associated themselves in heart with the intellectual festivities at Christiania.

We borrow from an excellent article by M. Peer Eketrae (in the Mercure de France, July, 1897) a list of such of Ibsen's works as have been published. It would be necessary to add thereto a few dramas of the period of youth that have been played, but not published:

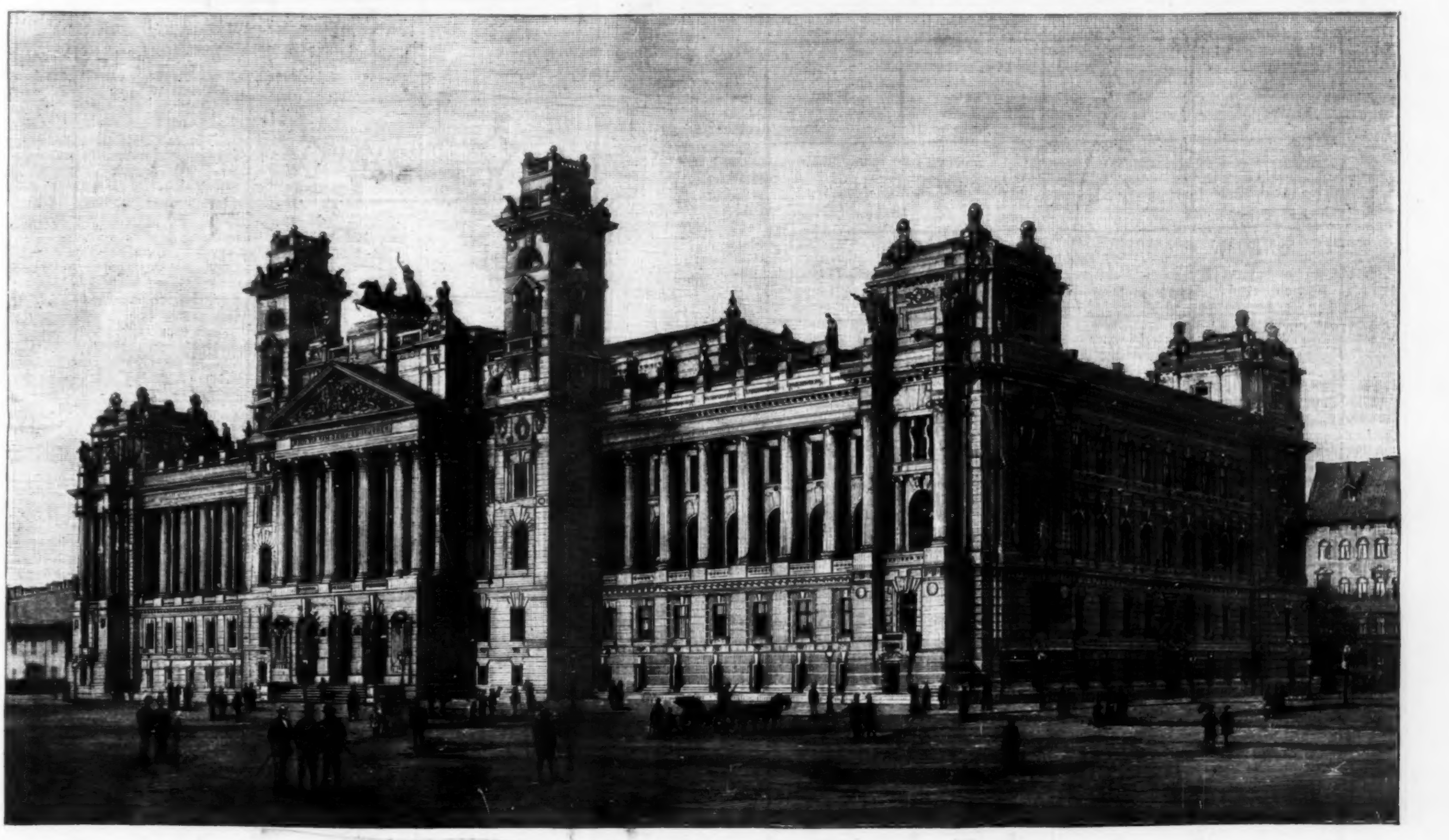
Catilina (1850). La Fête de Solhang (1856). La Châtelaine Inger d'Ostraad (1857). Les Guerriers à Helgeland (1858). La Comédie de l'Amour (1863). Les Prétendants à la Couronne (1864). Brand (1866). Peer Gynt (1867). L'Union des jeunes (1869). Empereur et Galiléen (1873). Les Colonnes de la société (1877). Une Maison de poupée (1880). Les Revenants (1881). Un Ennemi du peuple (1882). Le Canard sauvage (1884). Rosmersholm (1886). La Dame de la mer (1888). Hedda Gabler (1890). Le Constructeur Solness (1892). Le Petit Eyolf (1894). Jean-Gabriel Borkman (1896).—L'Illustration.

HENRIK IBSEN.

London will soon become the ideal home of the poor man. Lord Rowton, the well known private secretary of the late Lord Beaconsfield, is extending in every direction in the vast British metropolis his eminently successful scheme of cheap hotels, built and run on the same lines as the Mills hotels in this city, and now Sir Thomas Lipton has made arrangements to follow suit by establishing all over London restaurants of an analogous character, where substantial and good meals can be obtained for cost price. It is not proposed to run these restaurants at a loss, but neither is it intended to run them at a profit.

THE PALACE OF JUSTICE IN BUDAPEST.

THE new Palace of Justice at Budapest is a fine ornament to the Hungarian capital, which, on account of the Austro-Hungarian political conditions, has increased from year to year in size, the number of inhabitants and general importance. We publish herewith an engraving of this new building, which has been erected opposite the Parliament buildings, from the plans and under the direction of Alois v. Haussmann, at a cost of about $1,140,000, and is a structure worthy of the uses for which it is intended. The combination of Renaissance and Baroque styles is very effective. The façade, which is 439 feet 7 inches long, is built of sandstone, while the socle is of granite. Six enormous pillars ornament the central structure, which is flanked by two towers and crowned by a group of three horses drawing a chariot. The façade is richly decorated with figures and other ornaments, but the interior is finished with even more elegance. The main entrance leads into a large hall which extends up through three stories and is 131 feet long by 65 feet 7 inches wide. Two broad staircases lead up to the first story, where the hall is widened by loggia. Great arches supported on marble pillars give beautiful vistas into the inner rooms and corridors. Only the finest materials were employed in the construction of this elegant hall, so rich in architectural and artistic decoration; the pillars, staircases, balustrades, and floors are made of fine marble; and the central field of the arched ceiling is frescoed. The hall is lighted by two gigantic windows. There is a court at each end of this hall, and on the sides there are two banquet halls. There are one hundred and eighty halls and rooms in the Palace of Justice besides the nineteen court rooms, the fittings and arrangements of which not only fill every need, but also meet all requirements of the most refined taste.—Das Buch für Alle.



PALACE OF JUSTICE, BUDAPEST.

[Continued from SUPPLEMENT, No 1164, page 18608.]

THE PSYCHOLOGY OF INVENTION.*

By Prof. JOSIAH ROYCE, Harvard University.

INVENTIONS thus seem to be the results of the encouragement of individuality. Yet how individuality can be encouraged to go beyond its limits is a very serious problem. Here then is a new statement of our problem. The problem of the psychology of invention in the more important social cases becomes the problem of the psychology of the tendency called individualism. What sort of influence is it that puts the individual on his mettle, that awakens him to valuable and independent variability of habit, that, as they say, makes him let himself go? The problem is familiar in pedagogy. But can we suggest any new way of illustrating it when we approach it from the side of the psychology of invention?

In thinking over this problem, I have of course tried to inquire what form of experiment could be devised for the encouragement, in however slight a form, of something dimly resembling individuality and inventiveness. Inventors, I suppose, can be experimentally produced in the laboratory in some miniature shape. The miniature might indicate the nature of the great fact, and so I cannot forbear to bring before you the results, such as they are, of a few very insignificant efforts to produce a situation where the subject of an experiment should be encouraged to invent something. The small value that such experiments can have lies in the very simplicity of the conditions used, and in the fact that, in a very small miniature, such conditions may be made to simulate the motives that, in societies, seem connected with individualism.

It occurred to me to choose in a number of subjects a certain variable group of habits, and to submit this group to specific experiments. The habits chosen were to be not wholly unintelligent. On the other hand, they were to be habits not already too much subject to social training, or to reflective observation on the subject's own part. Furthermore, they were to be habits that could be exposed, first, to the workings of the private inventiveness of the subject himself, and, secondly, to the workings of a distinctly social stimulation—a stimulation of the same sort that exists when in a company of people we are urged to do our best, or are put on our mettle. My object was to get some glimmering of the way in which such a social stimulation becomes effective. In order to get my case simple enough to be of any value whatever, I had to put the subject in the dark as to the purpose of the experiment, and to make the social encouragement introduced of a very mild and minute type, so that I could regard it as a factor somewhat isolated from other factors in the conduct of the individual experiment. What I actually did—or rather began to do, for the brief time that has elapsed since I was asked to make this report has been too short to admit of any extended series of experiments—was this: Taking subjects in groups not too large to be controlled, I made each subject perform three, or in some experiments four, series of acts according to directions. In the complete experiments, where four series of acts were tried, the method was that, first, the subject was asked to draw on ten cards, one after another, and as quickly as possible, some figure or combination of curves and straight lines, which should not be an imitation of anything, so far as he could keep himself from such imitation. He was asked to throw aside each card as he drew it, and not to look back. He was asked to make his design each time as independent of former designs as possible. He was not to erase anything that he drew. He was to make each design at one movement. The plan of the first series having been carefully explained and understood, the subject, who was not to design until the experiment began, began at a signal, worked as fast as he could, and was required to finish the ten designs within two minutes. In the second series of ten, the subject was required to continue drawing new designs that imitated nothing and that were independent each time. "Draw something new each time," I said, "but this time be deliberate. Do what you do as carefully as possible, only throw aside each card as soon as it is done." This second series completed my test of the subject's independent inventiveness; that is, of his inventiveness apart from social stimulation.

Now, for the second half of my experimental test I wanted, as I said, to get a stimulus of the sort to put the man on his mettle, and one that still does not permit him to be satisfied with what he takes to be an imitation. In reading the history of inventions, and in observing in general the inventiveness of children, I have been much struck with the effectiveness in exciting originality of a certain motive which I may call the motive of being in a decidedly sharp contrast with one's social environment. This I should call one typical motive of all individualism. The child that desires to show himself off, the successful wit, the adept at repartee, the ambitious young poet, and in general a man of mark in an age of great individualism, all illustrate the psychological effectiveness, within certain limits, of the mere desire to make a contrast. A contrast of this sort is at first a vague ideal. It is, however, an ideal that tends to grow definite as it works. At first an illogical motive, it tends to grow more logical as it is applied. For the dwelling upon a contrast, the mere effort to show one's skill by reducing the contrast to some deeper sort of similarity, the studious effort to invent something that shall at once take account of the existing contrast, emphasize it, and, at the same time, reduce it to some sort of deeper uniformity with its opposites, this has been a motive even in the pursuit of the soberest science. Such a motive led, for instance, to Plato's philosophy, or to the mathematical concepts of zero and of negative quantities. Before I ventured on the experimental suggestion of the second half of the experiment, I accordingly said to the subject: I am now going to show you in succession ten cards drawn at random, just as you have been drawing yours. As your third series, I want you, on the sight of each card, to draw at once and without the least reflection some object that feels to you at the moment when you draw it like a new design, but that also feels as unlike as possible to the object that you see. I added the observation that the subject must find out for himself in each case what "unlike" meant; that I could not tell him beforehand; and that I simply wanted him to draw as well as he could. It was simply this stimulus of the unlike, this Geist der stets verneint, which constitutes the Mephistopheles that I wanted for stirring up my subjects;* and I suppose that we shall all agree as to the interest of any attempt to get the devil to assist in a bit of experimental psychology. After ten such cards had been drawn, I then let the subject at his leisure compare these cards, one after another, with the model, deliberately consider whether he had made them as unlike as possible, and draw a fourth series of cards containing if possible new unlikenesses and unlikenesses as great as possible. In some of the earlier experiments, for fear of wearying the subject, I at first used only three series of experiments, omitting what later became the second set, namely, the deliberate efforts at unaided invention. But in most of the experiments four sets were used.†

Throughout the experiment great care was taken to give all the subjects concerned the same directions, and to make the inevitable suggestions involved in these directions as uniform as possible. Thus, I had to make clear that the designs were not to be imitative of any object. In making this statement I used always the same names of objects, or rather of classes of objects, to indicate the nature of this exclusion. I said, "No character of an alphabet, no picture of an object," and so forth, using as nearly as possible the same formula, although I often had to repeat or slightly to vary my phrase in order to make the matter perfectly clear to each subject before beginning. In presenting the objects that were to serve as the stimulation of the unlike I used a set of drawings very much resembling in their random type the sorts of drawings that I expected to get from the experiment. I used the same set of presented drawings throughout. In one case the drawings were presented in a very slightly altered order. But as di-

* Read before the annual meeting of the American Psychological Association, held at Ithaca, December 28, 1897.—With acknowledgments to The Psychological Review.

* Des Menschen Thätigkeit kann allzu leicht erschlafen
Drum geb' ich gern ihm den Gesellen zu,
Der reizt und wirkt und muss als Teufel, schaffen.

† I must explain, to avoid an obvious misunderstanding, that I do not suppose any true poets, or other inventors, to be guided by so gross a motive as the one here used, viz., by the motive to be merely as unlike as possible to their predecessors. I have wished to isolate the motive explained in the text. Hence the grossly abstract form here given to this motive.

rect suggestion from the particular drawing presented played a decidedly minor part in any single resulting drawing, this one change of order seems to have been of small importance. Yet I should of course avoid it in any final preparation for drawing detailed conclusions from further experiments. In the fourth column experiments of the charts presented, the subjects commonly had the opportunity to see more than one of the drawings at the time, but as they had by this time seen them all once and were now engaged in a fixed effort of attention comparing their own work with the particular drawing, I did not deem it necessary at this stage to guard against such manifold suggestions. In general, as I just said, direct suggestions from the drawings shown played a minor part in the results. The experiments test, therefore, in a rough way, the results of one interference nearly constant in all cases.

Now I need not say that it was far from my thought to obtain from such experiments any final or exact results whatever. I regarded them, and regard them, merely as giving a first glimpse into the labyrinth of the influence of social suggestion upon individual inventiveness. I should be in such a case well satisfied to find that a stimulus of this sort gave results that made it seem in any sense an encouragement of individuality. I can best deal with the experiments and their suggestiveness by presenting to you the enlarged charts of twelve results.*

An examination of these charts as to their general appearance will first indicate that they are, to say the least, suggestive of a possible method for the study of individual psychology. The first ten, the independent drawings, have a very decidedly individual range of variation and uniformity. Each person challenged to draw ten designs of this sort will draw a set of designs that obviously stand for a system of habits, some of them no doubt technical and conscious at some time in the past or even at present — some of them, however, especially in people not accustomed to drawing, habits more or less subconscious. They vary from individual to individual in a way that is certainly worth observing. I suppose that the particular experiment taps but a very small portion of the world of motor habits here involved. The second column's work in the four-column cases in our charts would stand of course for the second ten, namely, the results of deliberate individual effort to vary the designs. These efforts, of course, made thus hastily, cannot be regarded as just to the individual's actual range of power to construct such designs. But they do illustrate what habits of the individual belonging to this range were just then at control under the conditions of this experiment. Now comes the stimulus in the form of the requirement: See that and make the unlike. What will the individual do under such circumstances? Will he helplessly follow the suggestions of the models presented, and make something like them in trying to make the unlike? Will he do what he might well do, namely, simply continue the style of his private inventions of this type, without variation of style? If he did this latter, he would in general make something decidedly unlike the models shown. Will he start upon an entirely new track? Will he be frightened out of his inventiveness altogether and be unable to make any designs? Or will he, finally, be stimulated to become more inventive, whether by combining his own style with the presented styles or by striking off on entirely original lines? Very naturally, I found subjects who did nearly every one of these things. The actual range of variation in some eighty cases* where the experiment was tried is considerably greater than in the charts here displayed. I took, however, some of the most striking results for consideration. And I may ask you at this point to form your own opinion on the cases presented.

The subjects of the experiments vary greatly in training and in age. I begin with the case of a workingman, aged 47, a stitcher by trade, a member of a workingmen's club, and performing the experiments with undoubted good will. He had no warning of the nature of the work and is of course without psychological training. You see (Fig. 1) that he begins his independent designs with very short curved marks without apparent ideas of any objects, and with variation merely in the direction of this or that small feature of the curves used. His second column—that of his deliberate but still uninfluenced invention—involves making small objects of an indefinite character. The rather rough method of reproduction here used—namely, a pantagraph pencil marking marked over with crayon—is somewhat unjust to the smaller outlines of his drawings. The last one tended in the original to look somewhat like a glove. All are small objects with closed outlines; a rounded form predominates. The type is one that could not very widely vary. The last figure suggests that the subject could not go further without drawing genuine objects. With the third column began the successive display of the cards which were to stimulate the subject to make the "unlike." Notice at once the very marked change. At once his entire style altered. The first alteration is, as it chances, a distinct suggestion from the model. This character remains, although not in a very marked way, in later cases. It soon becomes hard to say in what fashion the subject was influenced by the individual object seen; or at all events, where this suggestion can be traced, it is usually of a rather general character. But mark, whether you call it individual suggestion or not, there can be no doubt our subject is trying to make his objects unlike; and there can be no doubt that in so doing his inventiveness is increased. It is noticeable that all these cases were made very rapidly, within a little more than two minutes for the whole ten. The cards were seen and taken down at once. The fourth column shows still a new character. The subjects return to simplification. He is now deliberate. He is not so inventive in novel forms. In his case, the stimulus works best as the cause of variation in his habits and association, or, if you like, in his selections from among his habits, when the stimulus works quickly. In any case, there can be no doubt of the actual importance of the new stimulus as a cause of variation.

A notable contrast exists between the foregoing case and No. 2. Here the subject is a young lady, an elementary student of psychology, with a reputation as a clever and successful student. Like the foregoing subject, this subject disclaims any skill in drawing. In the first column are independent designs drawn without deliberation. The subject was given in this case no opportunity to develop her independent inventiveness. Doubtless, if left to herself, she could have made her scroll work considerably more complex. But the habit is a highly developed one. When questioned, the subject declared that it had long existed, and was a subconscious habit—namely, the habit of making symmetrical curved forms for amusement. Technical skill was not reported in this case as being in any way responsible for the forms. In the second column the intruder appeared. Here a rapid and important change occurs. For the moment the subject is, as it were, "all broken up" by the requirement to make the unlike and to make it quickly. The formless scrolls resulting are of course not genuine novelties, but do represent, apparently, either a reversion to the very early habits or a disintegration of existing ones. Whatever the effect, it is only momentary, although the effect of suggestion from the cards shown is visible and yet productive of no valuable result. With the fourth case the subject begins to return to her own style. Her scroll-work habit rises again to the surface. It is now more elaborate than ever, although no more deliberation is allowed. The slighter influences of suggestion from the models are not invisible. They act to produce more varied forms, which are, perhaps, not less worthy of regard. But when, in the third column, the subject is given a chance to deliberate, she produces in the first, third, and fourth cases forms which are useful combinations of her own bias for symmetry with suggestions due no doubt to the objects seen. In notes which the subject independently made upon the latter cases of this third column, notes made while she drew the deliberate forms, she explained, with a certain naivete, that since the figures which she saw were in these cases unsymmetrical, she might as well oppose bi-lateral symmetry to them as her own invention of the unlike. She was plainly unconscious at the moment of the prevalence of such symmetry in her now unseen drawings of the first group. Afterward she said she recognized the permanence and depth of the subconscious habits involved.

This case introduces us to a type present with the most manifold variations in numerous cases among our experiments. I should venture to call this the self-preservative type. It is notable that the forms produced in our first column would in general serve well enough to fulfill the vague requirement of the "as unlike as possible." The subject whom we first considered was unable to make use of the forms of the first column when the intruder first appeared. His "unlike" had to be a

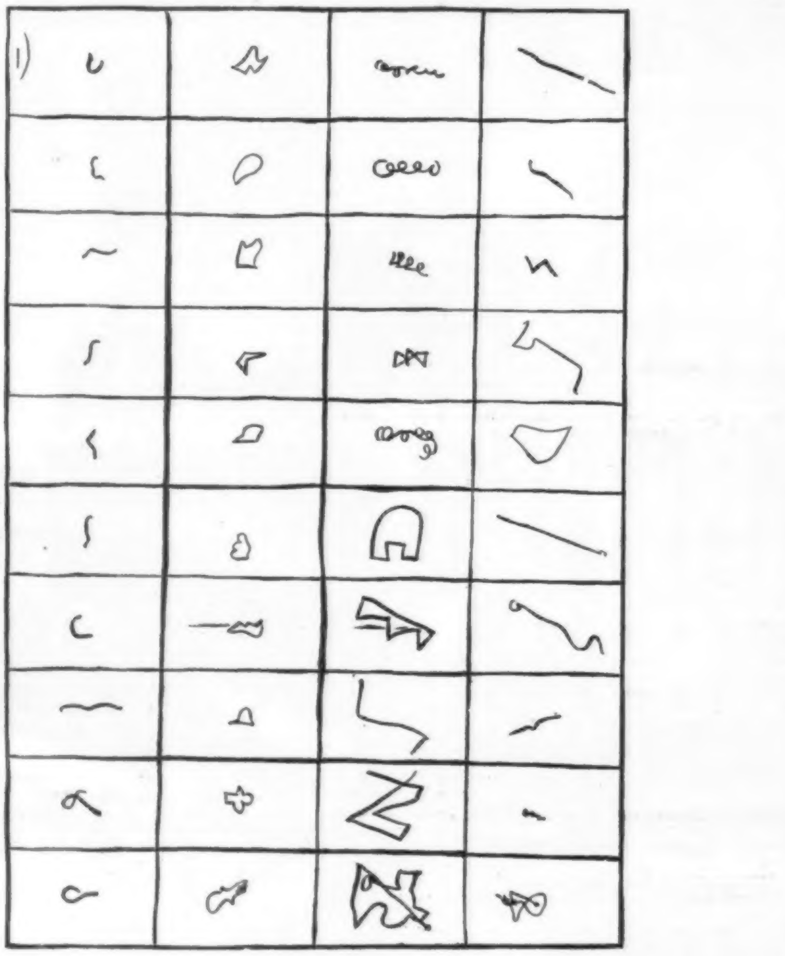


Fig. 1.

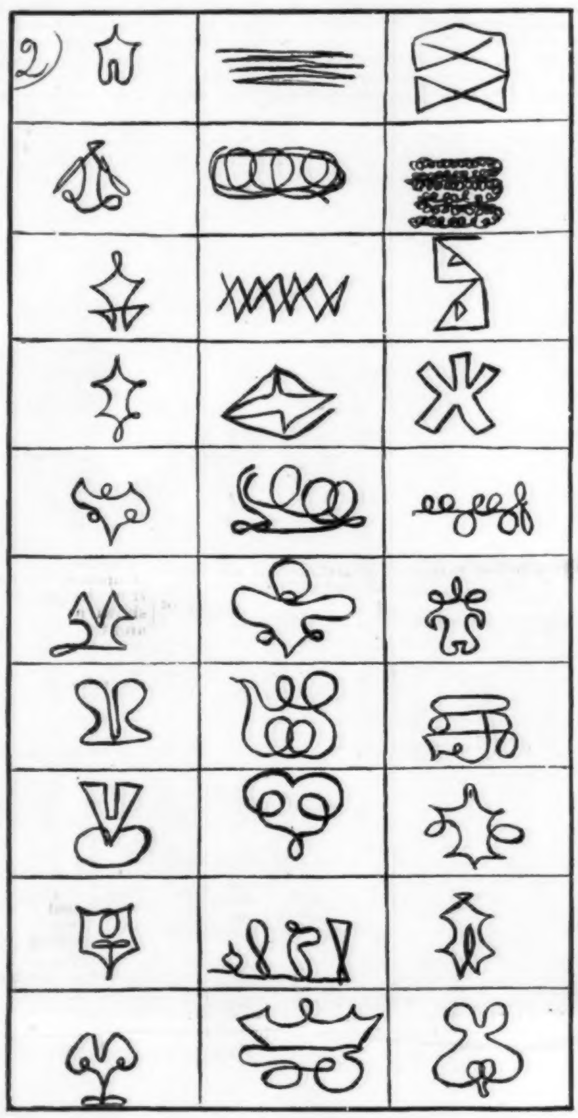


Fig. 2.

* Of the charts here presented, the first three and the twelfth are reproduced in the figures numbered 1, 2, 3 and 4. The figures given are intended to show in brief rather the way in which the cases varied than the degree of inventiveness actually to be found. Of the latter only a statistical estimate could be of service. A preliminary but pretty careful study of 40 cases, the work of people of both sexes, and of widely varying ages and occupations, showed 24 out of the 40 as cases where in the later columns, as compared with the earlier, a decided increase of inventiveness could be observed. I give this not as a result, but as a mere beginning.

* Out of these eighty cases were chosen, at random, the forty that were submitted to the more careful statistical study mentioned in the previous note. The value of the estimates made can be, in a measure, tested by comparing the text and the plates in the four cases here reproduced. More careful statistical studies, with a fuller statement of the methods of estimate used, will, I hope, be given hereafter. It has not been possible to reproduce here in plates the drawings used as the stimulus for the "unlike." They were a set of rude outlines, of the general character here in question.

new invention. In the present case, after the momentary scattering of the subject's habits by the intruder, the subject returned to the type of the first column. But it is notable that in returning to this type she returns to it in an enriched and more variable form. She preserves her own fashion, but with an addition which leads in two or three cases of the last column to what one might call a genuine novelty, namely, a new type of symmetrical figure.

(To be continued.)

THE PROTECTION OF INDUSTRIAL PROPERTY.*

By J. F. ISELIN.

THE subject with which I propose to deal is one of no small importance. Yet it has hitherto attracted so little attention in this country that the title which I have given to this paper is not one which is generally known or understood, although it has been officially recognized by the government of the country in treaties to which Great Britain is a party.

The term "Industrial Property," like many other general terms, is a French one. It expresses a conception which exists indeed in this country, but for which no generally accepted name has yet arisen.

There is a class of legal rights whose importance is almost wholly modern, which includes the right of an inventor to the fruits of his invention, of an author or artist to the work of literature or art which he has produced, of a trader to the mark which he uses to distinguish his goods, or to the name and good will of the business which have been made valuable by his skill and industry, and those of his partners and predecessors. These rights are in every respect analogous to ordinary rights of property, except, perhaps, that there is no material object to which they relate.

These rights are in French law comprised under the head of intellectual property (propriété intellectuelle), and this again is divided into literary and artistic property on the one hand and industrial property on the other. The first of these corresponds almost exactly with what is called in England copyright, except that copyright in designs intended for manufacturing and industrial purposes would in France come under the head of industrial property. The French classification has made its way over the Continent of Europe, and is not without influence in this country also, because it is observed in the international treaties upon the subject. Literary and artistic works are protected by the Berne Convention of 1887, while patents, trade marks and designs depend upon the Paris Convention of 1883, together with certain amendments made to it at Madrid in 1891. The subject of this paper is the latter only—that is to say, patents, trade marks, designs and certain other rights of the same kind. And I intend to consider the subject almost entirely from an international point of view.

The subject can be conveniently dealt with in an historical manner. The practice of securing the fruits of an invention to the inventor by giving him an exclusive right to use it was introduced, I believe, by the Tudor kings of England. The use which was made of the power of granting patents by Queen Elizabeth and by James I. led to a very severe struggle between the Crown and Parliament, which was finally settled in 1621 by the passing of the Statute of Monopolies, whereby it was declared that "all monopolies and all commissions, grants, licenses, charters and letters patent heretofore made or granted . . . of or for the sole buying, selling, making, working or using of anything . . . are altogether contrary to the laws of this realm;" but an exception was made in favor of "letters patent and grants of privileges for the term of fourteen years or under, hereafter to be made, of the sole working or making of any manner of new manufactures within this realm, to the true and first inventor and inventors of such manufactures, which others at the time of making such letters patent and grants shall not use."

This provision is the basis of our existing Patent Law. In consequence of the point of view which I am taking, it is necessary to point out that the law has always been interpreted in a strictly national manner, so that the person who introduces a new manufacture into the country is regarded as entitled to a patent for it, even though it be admitted that the actual invention has been made in a foreign country by some one else.

The protection of trade marks was introduced by the courts about the beginning of this century; that of designs was created by Act of Parliament in 1787. Numerous Acts of Parliament were subsequently passed dealing with all these subjects, and the whole law dealing with them all was consolidated and amended by the Patents, Designs and Trade Marks Act of 1883. The other parts of industrial property have all come into special prominence during the last few years, and have been regulated partly by the decisions of the courts, and partly by Acts of Parliament, the most important of which is undoubtedly the Merchandise Marks Act, 1887.

The reason which has made these subjects of special importance during the present century is the great growth of commerce and manufactures which began, roughly speaking, about the middle of the last century. But the movement for securing rights of industrial property for foreigners dates back only about a quarter of a century. The first impulse was given in 1873. In that year a Congress was held at Vienna on the occasion of the International Exhibition, which appointed a committee to work for the realization of the principles which had been then laid down. At a subsequent Congress, which was held in connection with the Paris Universal Exhibition of 1878, a project for the formation of an International Union for the Protection of Industrial Property was brought forward by the Austrian Society of Architects and Engineers. The Congress appointed a Permanent Commission to consider the project, and the French section of the Permanent Commission produced a draft which was laid before a diplomatic conference convened by the French government in 1880, and served as the basis of the Treaty of Union, which was signed by eleven Powers (Belgium, Brazil, France, Guatemala, Italy, the Netherlands, Portugal, Salvador, Servia, Spain and Switzerland) in 1883. The scope of the Union has since been widened by the adhesion of numerous other states (Great Britain, Tunis and San Domingo in 1884, Sweden and Norway in 1885, the United States in 1887, and Denmark in 1894), so that it may now be said that the only great states which still remain outside it are Germany, Austria and Russia, and of these Austria last year gave notice of her intention to become a member of the Union.

It will not, I think, serve any good purpose to give here the provisions of the Paris Convention in full, but it is necessary to give a short account of its main provisions.

It begins by constituting the states which are parties to it into a Union, which any state is entitled to join by giving notice to the Swiss government. It is next provided that the subjects or citizens of any state which is a member of the Union shall enjoy in all the other contracting states all the advantages which the law of that country gives to natives as regards patents for inventions, industrial designs or models, trade marks and trade names. This is carried out by giving to any person who applies for a patent, or registers a design or trade mark, a certain period (which is six months in the case of patents and three in those of designs and trade marks) during which he enjoys a right of priority, and cannot be anticipated, or have his right destroyed, by the acts of other persons. The working of this provision may be shown by a simple example. A man patents an invention in France. Shortly after some one else takes out a patent for, or works, the invention in this country. The acts of the second inventor will not be any obstacle to the grant or to the validity of a patent in England to the original inventor, provided he makes application before the period of six months has expired.

To meet the very harsh laws relating to the working of patents which exist in many countries, it is provided that patentees shall be entitled to import patented articles into the country where the patent has been granted without liability to the forfeiture which the law sometimes decrees, as in France. On the other hand, the compulsory working clause—of the existence of which on the Continent so much complaint is made in this country and in the United States—is left unaffected.

As regards trade marks, it is provided that they shall be admitted for registration and protection in every State of the Union, "in the form originally registered in the country of origin." This article, and the preceding one—which deals with the compulsory working of patents—have been the subject of much difficulty and controversy ever since the convention was signed. I mention this here, shortly, because I intend to return to the subject later.

It is further provided that trade marks shall be protected in every country of the Union without any necessity for registration; while all goods falsely or unlawfully bearing a trade name or trade mark, or the name of a place with the addition of a fictitious trade name, or one borrowed with a fraudulent intention, are liable to seizure upon importation into a State of the Union.

Finally, the contracting States undertake to grant temporary protection to patentable inventions, industrial designs and models and trade marks, which are shown at an international exhibition in their territory, and to establish a special government department of industrial property, and an office for the publication of patented inventions, designs and trade marks. A central office was created at Berne, under the supervision of the Swiss government, for the purpose of collecting and publishing information of all kinds relating to industrial property. The creation of this central office is, perhaps, not the least valuable result produced by the convention of Paris. It publishes a monthly journal, La Propriété Industrielle, which contains most valuable information, and it is at the present time engaged in publishing a collection of all the industrial property laws of the world.

The convention provided for periodical conferences to revise and amend it. Three of these have been held up to the present. The first, which was held at Rome, in 1886, led to no result, and the amendments, which were carried after much discussion and difference of opinion, were not ratified by the governments of the contracting States.

The next, which met at Madrid four years after, was more successful. It produced four protocols. One was not ratified on account of the great opposition which it met in several States. Another has not yet been ratified by Servia and San Domingo and has, therefore, not yet come into force. A third relates to the substitution of a single registration at Berne for the many registrations which would otherwise be necessary in order to obtain complete legal protection for a trade mark in all the States of the Union. This is a mere question of administrative machinery, with which it is not necessary for us to concern ourselves, more particularly as for special reasons this country has hitherto been unable to become a party to it. The fourth, which is usually referred to as the Madrid arrangement, will require a little more consideration. This relates to what are called "false indications of origin" on goods—a subject which occupies a large place in the much discussed Merchandise Marks Act of 1887. It provides that all goods bearing an indication of origin which falsely describes any of the contracting States or a place situated in one of them as the place of origin of the goods shall be liable to seizure upon introduction into any of the contracting States. But it is provided that a seller shall not be prevented from placing his name or address on goods which come from a country different from that of sale, provided he at the same time clearly states where the goods actually come from. There is also an exception as regards place names which have become mere generic designations, and have thus ceased to be understood as indicating the place of origin of the goods—as, for example, Russian leather, Epsom salts, Brussels carpets. It is left to the courts of the different countries to decide which these are, but by a remarkable inconsistency, which is probably destined to give rise to a good many difficulties, it is specially stated that "regional appellations relating to the products of the vine" shall not be liable to be considered as generic designations, but must always be considered as indicating the origin of the wines or spirits to which they are applied. On account, probably, of the stringency of these provisions, this protocol was signed only by seven powers—Brazil, France, Great Britain, Portugal, Spain, Switzerland and Tunis.

The last of these conferences was held at Brussels in December of last year. The result of its deliberations has not yet become generally known. I have applied to the Foreign Office for information, but have not yet received a definite reply. From another source it has come to my knowledge that four subjects of special importance and difficulty have been reserved for further discussion at a later meeting of the conference, which is to be held, if possible, in the course of the present year. These are: the right of priority, the compulsory working of patents, the conditions of registration of foreign trade marks, and what is called on the Continent of Europe and in the United States "unfair competition," although the name has not yet found acceptance in this country. The term is applied to all those numerous cases where a trader attempts to appropriate or to destroy a part of the good will of a rival's business, the results of his skill and industry, without directly using either his name or his trade mark.

While the governments were thus progressing, private individuals were not idle. Congresses were held at the Paris Exhibition of 1889 and the Chicago Exhibition of 1893, but they appear to have dealt rather with general principles than with practical details, and but little seems to have resulted from their deliberations.

A more important movement arose in Germany and Austria, and it is to this that I desire to direct special attention. It had occurred to some people in these countries that it was undesirable for them to continue to remain outside the Union. Societies for the Protection of Industrial Property were founded in Germany and Austria, and at a conference of these societies which was held at Berlin in October, 1896, it was decided that an International Association should be formed, on the model of the International Literary and Artistic Association, which brought about the Berne Copyright Convention, for the purpose of holding periodical congresses for discussion, and of working for the extension and improvement of the existing Union and its treaties.

For this purpose negotiations were entered into with some of the most influential persons interested in the matter in England, France and other countries, and a meeting was held at Brussels in May of last year, at which the Association was definitely constituted and provided with an executive committee. The first congress of the Association was held at Vienna in October, and was attended by a large number of persons, including representatives of the French, German, Austrian, Belgian and United States governments, as well as of seventeen Continental Chambers of Commerce and many trade societies of great importance. I understand that the proposals which were adopted by the congress were laid before the diplomatic conference which met in Brussels, and were to a great extent accepted. This Association, which was founded less than a year ago, now numbers about 400 members. It has up to the present not met with much success in this country, although it already includes some of the principal members of the bar who are interested in these questions, and many of the principal patent agents.

I am persuaded that it has only to be better known to show the great service which it should be capable of doing in this country, where all matters connected with trade and commerce are always certain of receiving full and careful consideration.

It has been decided to hold the next Congress of the Association in London at the beginning of June. I have here several copies of the programme, which I shall be glad to give to any one who is sufficiently interested in the matter.

I should like, in conclusion, to give you one or two instances of the manner in which, as I think, the Association and its Congresses may be of use to British trade.

There is, first of all, the question of the compulsory working of patents, to which I have before alluded. In all countries, except England and the United States, it is provided with more or less stringency in the patent law that every patented invention shall be worked in the country by the production of the patented article there, under penalty of forfeiture if the invention is not worked within a certain period, generally two years. In France the law is even more severe, and the patentee is forbidden to import the patented article into the country under penalty of forfeiture. In this country, on the other hand, we have only a provision empowering the Board of Trade to grant licenses to manufacturers to work patented inventions upon such conditions as the Board consider just, but only in cases which are so infrequent that, I believe, hitherto it has never been found necessary to make use of the provision. The most severe part of the French law, that relating to the importation of patented articles, has, no doubt, been modified by the Convention of Paris; but the compulsory working clause remains intact both there and elsewhere. It is not unnatural, therefore, that manufacturers in this country consider themselves unfairly treated. Of late, opinion in Germany has become more and more opposed to the maintenance of the compulsory working clause; and a very able paper in this sense was read last year at the Vienna Congress by Mr. von Schütz, of the firm of Krupp. The opposition to its abolition comes from France and Belgium; yet, even there, it shows signs of giving way. The Association seems to me well qualified to help on the movement for the suppression of the compulsory working clause.

In regard to trade marks a position of no less difficulty has arisen. Although the Convention of Paris provides that trade marks, if duly registered in the country of origin, shall be admitted for registration and protection in every country of the Union in the form originally registered, and the act of 1883 was supposed to be sufficient to carry it into effect, it was found that the comptroller refused to register foreign trade marks unless they were such as the English law would recognize as trade marks. On two occasions an appeal was taken to the courts, and on each occasion the courts upheld the decision of the comptroller. He therefore continues to exercise his jurisdiction in accordance with the anomalous standards of the English law, and it is commonly said in France that we have not carried out the obligations into which we entered by signing the convention. The congress of the association should provide an opportunity for the discussion of the sub-

* Paper read before the Society of Arts, February 16, 1898.

ject, and for the arrangement of measures for removing the injustice, if one exists.

Thirdly, there is the question of false indications of origin, or as we prefer to call them, false trade descriptions. It is a matter of common knowledge that in 1887 Parliament passed an act of great stringency for the purpose of dealing with fraudulent descriptions of this kind. Everyone knows also that some people think that we are paying rather heavily for our (as they think) excessive honesty in this matter, and that a very fierce controversy has recently taken place on the subject. Nevertheless, everyone is agreed that we should do our best to induce foreign nations to imitate us. The congress will provide an opportunity of showing them how far we are ahead of them, and of expressing our wishes that they should follow our example. In the meantime, however, we have entered into a treaty by which we are bound to protect the names of wine-growing countries against appropriation by persons outside of them. Does our law insure that this will be done? There are circumstances which seem to cast a doubt upon it. Here again the congress will afford an opportunity for discussion and consideration.

In 1896 Germany passed a law on the subject of unfair competition. The law contains a section providing that its benefits may be extended to the members of states which protect Germans by means of a notice in The Imperial Bulletin of Laws. There is no question that our law protects Germans, and that it is not less favorable than the German law. Yet the necessary notice extending protection to British subjects has not yet been issued, and one may perhaps believe that it is meant to be purchased by some further concession. The association should afford the means of bringing pressure to bear upon the German government.

Again, suppose a patentee has an invention which he wishes to patent in many countries. He will find that he has to comply with numerous and different sets of rules as to the form in which his application must be made, and often he will have to send in drawings of the same invention reduced to many different scales. Much may be done to help the inventor by making these regulations, particularly as to drawings, uniform —and this is the sort of work which the association will do. Or an inventor's position as regards searching for anticipations of his invention may be improved by making the classification of patents in different countries uniform—and this also the association proposes to do.

These matters seem to me of some importance. There must be many people to whom the proper decision of questions such as these is a matter of great pecuniary interest. These are but a few of the questions which are open for discussion. I have here a list of some more in the programme of the congress. New ones are arising every day. If you take any interest in the subject, or in the association and its congress, I can give you as much more information as you please, and, may I add, the committee of the congress will be glad of all the assistance you can give it.

A NEW ACETYLENE GENERATOR.

THE Prussian Minister of Public Works has recently decreed that hereafter a mixture of oil and acetylene gases shall be employed for the lighting of the cars upon the government railway lines. This mixture consists of three parts of oil gas and one part of acetylene, and gives an illumination of 16 candles for a consumption of about one cubic foot an hour.

Here again we have been outdone by our neighbors in the exploitation of a new process of lighting that the experiments made in France have greatly contributed toward bringing into prominence. After the satisfactory experiments of M. Chaperon on the Paris-Lyons-Mediterranean line in 1895, and of MM. Dumont and Hubon on the Railway of the East in 1896, has not a fitting solution of the problem been found? Or are we waiting, in order to be certain of coming in at the finish, until the majority of foreign companies have adopted acetylene for the lighting of their cars?

It must be admitted, without any fear of showing ourselves too exacting, that our railway cars should be better lighted. Fortunately, we are not getting discouraged, and researches are ever making with the same assiduity. Acetylene, which a few years ago had numerous detractors, seems now to have won its way, and the use of it is rapidly becoming general, owing to its numerous applications. The idea that first occurred was to produce it in central works and distribute it by pipes as is done with coal gas. The small volume of acetylene necessary to obtain a large amount of light would have permitted of laying pipes of very small diameter, and consequently of diminishing the cost of the first establishment. Moreover, since the gas is absolutely fixed, no frost could interfere with it. But, in order to be burned, acetylene requires a much higher pressure than coal gas, and from this may result leakages and explosions. So up to the present, the idea of distributing it by pipes has been abandoned. It has been principally used in private installations. In country seats and in towns that are not supplied with coal gas, lighting with acetylene is the cheapest and most practical process. In this case, generators in which the acetylene is produced by the fall of calcium carbide into water are employed. The gas is formed cold, since all the heat disengaged by the decomposition of the carbide is absorbed by the water, the temperature of which rises only a few degrees. On the contrary, in apparatus in which the water falls upon the carbide there is a considerable disengagement of heat. The gas becomes charged with the vapor of benzine and naphthaline, which diminishes its illuminating power to a notable degree and fouls the pipes.

The generators should contain a sufficient quantity of carbide to last for a week without renewal, during a normal operation. They may occasionally be made to vary in their operation and discharge, for example, in case of receptions, a volume of gas corresponding to the consumption of all the burners during the entire night, that is to say, the same apparatus may supply ten burners of 120 cubic inches five hours a day for a week, or forty burners of 240 cubic inches for ten hours during the same evening.

The following is a description of a new generator recently put upon the market by the Société Internationale d'Acetylene.

The apparatus consists (1) of a reservoir, C (Fig. 2), containing granulated calcium carbide; (2) of a tank, A, filled with water up to within 4 inches of the edge, and in which the acetylene gas is formed; (3) of a gas holder, B, which moves in the tank, A; (4) of a vertical rod, T, provided with two conical parts, one of which (D) regulates the fall of the carbide into the

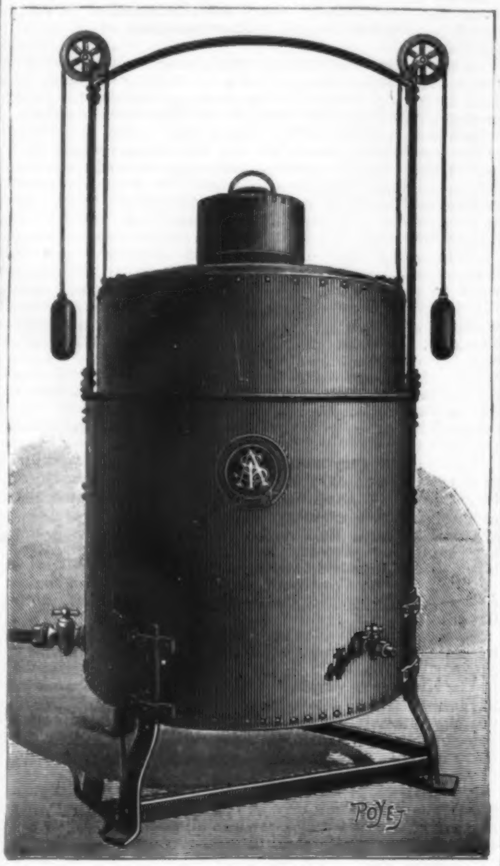


FIG. 1.—A NEW ACETYLENE GENERATOR.

tank, A, and the other (δ) distributes it in all directions; and (5) of a disk, K, against which the vertical rod abuts when the column, B, moves downward. The operation of the apparatus is very simple. After the tank, A, has been filled with water and the holder, B, has been suspended, the carbide is introduced into the reservoir, C, and the cap, F, is screwed down. The holder is then disengaged from its stops, and, in order to permit it to descend, the cock of the tube, O, is opened so that the confined air may escape. The

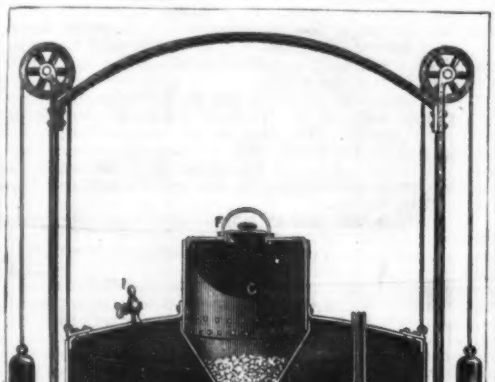


FIG. 2.—VERTICAL SECTION OF THE GENERATOR.

A, tank; B, gas holder; C, carbide reservoir; D, valve; E, external reservoir; F, closing device; G G, ring for weighting the holder; H H, counterpoises; I, air cock; J, discharge cock; K, disk; L, safety tube; N, water level; O, gas tube; S, external tank; T, valve rod; X, starting and stopping lever; Z, pin for fixing the lever.

holder, under the action of its own weight, begins to descend and carries along with it the rod, T, which comes into contact with the disk, K. At this moment the valve rises and gives passage to a certain quantity of carbide, which falls into the water of the tank, A. Acetylene gas is immediately produced and enters the

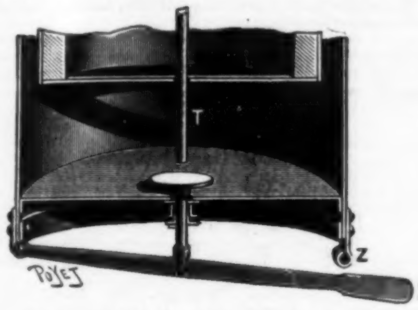


FIG. 3.—APPARATUS AT REST, WITH LEVER DEPRESSED.

holder, B, which rises; and the valve, D, resuming its normal position, arrests the fall of the carbide.

This motion of the holder, B, continues as long as the reservoir, C, contains any carbide. When the supply is exhausted, it suffices, in order to put the apparatus in a state to operate, to fix the holder on

FIG. 4.—APPLICATION OF THE GENERATOR TO STREET LAMPS.

its stops, to empty the tank, put water into it again, and then fill the reservoir, C, with carbide.

In order to prevent any stoppage in the operation of the apparatus, in cases in which a continuous production of acetylene is necessary, a second receptacle is arranged above the reservoir, C. This receptacle, which

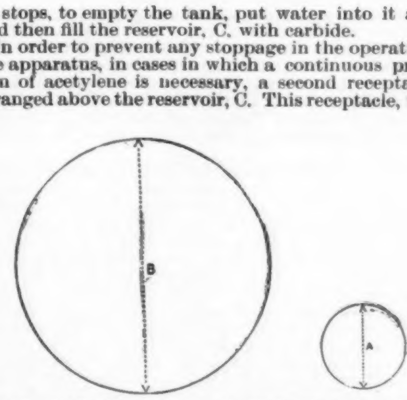


FIG. 5.—COMPARATIVE DIAMETERS OF ACETYLENE (A) AND COAL GAS (B) CONDUITS.

also contains carbide, supplies C through the simple maneuver of a cock, in measure as the gas is consumed.

As these generators are of pretty large dimensions, it became necessary (seeing the difficulty presented by the handling of the holder, owing to its weight) to seek an arrangement that should permit of easily setting the apparatus in operation. To this effect, the rod of the disk, K, has been provided with a lever. When the latter is raised, the disk, when there is a very slight

displacement of the holder, B, abuts against the extremity of the rod, T, the valve, D, is lifted, and the production of acetylene immediately begins. When the lever is depressed, the distance that the rod, T, has to travel in order to come into contact with the disk is too great, and the disengagement of the gas ceases.

There is no danger connected with the use of this apparatus, since its operation is automatic, and no overproduction can occur. If, however, as a result of any imprudence, an overproduction should take place, it would be shown by water being ejected from the tank.

The quantity of gas manufactured is proportional to the size of the generators, which, in the majority of cases, can be arranged in a courtyard or a garden.

One interesting application to which these gas generators lend themselves is the lighting of public streets, parks, etc.

From the viewpoint of the intensity of light as well as from that of economy, we know that there would be a great advantage in the substitution of acetylene for gas and electricity, and especially for oil and kerosene; but this change has not yet been made, because it has been supposed that it would necessitate the onerous installation of gas works and subterranean pipes. This is not at all the case. Small sizes of the gas generators above described may be arranged even in the base of lamp posts, and give a steady light of 20 candle power for nine or ten hours. The installation necessitates but a trifling expense, and, in a city owning a hundred lamp posts, two men suffice to clean and charge the apparatus.

In installations of acetylene lighting, the diameter of the conduits should be a third of that of ordinary gas mains. Fig. 5 represents the ratio between the two dimensions. Under the same loss of charge, the acetylene conduit, A, and the coal gas conduit, B, of three times greater diameter, give the same amount of light.

For the illustrations and the above particulars, we are indebted to La Revue Technique.

PALEOLITHIC MAN.*

IN the address of last year the evidence for the existence of man in the Tertiary period was reviewed, and although some of the evidence was very cogent, yet in no case did it amount to a proof, such as is necessarily demanded before so great an antiquity can be accepted for the human race. On the other hand, the presence of man in Quaternary times has long since been proved by the presence of many undoubted flint implements, in cave and river deposits of Pleistocene age and in relation with the bones of the mammoth and other extinct mammalia.

But other questions have now to be answered. What were the physical and intellectual peculiarities of the men who made the paleolithic implements? Have any parts of his skeleton yet been found?

Human bones and skeletons, more or less imperfect, supposed to be of Pleistocene age, have often been recorded both in this country and also on the Continent of Europe; but a close investigation has, in most cases, proved them to be of much more recent origin, or has shown that there were very grave doubts as to their authenticity.

Much has been done to eliminate the doubtful records by such writers as Prof. Boyd Dawkins, M. Gabriel de Mortillet and MM. Fraipont and Lohest; and consequently it is only necessary at the present time to consider the more important of these discoveries, and especially those which have been made within the last ten or fifteen years.

The famous Canstadt skull, described by Jaeger in 1835, is of uncertain origin, for when the mammalian remains, with which it was supposed to have been associated, were first described in the year 1700, no mention was made of this skull, and it is, therefore, by no means certain that it was associated with these extinct mammals. A new interest is awakened in this and some other of the earlier and unauthenticated remains of man by the discovery, within the last twelve years, of very similar skulls which are accepted as of paleolithic age. The skull discovered by M. Faudel in 1865, at Eguisheim on the Lower Rhine, is not unlike that from Canstadt, and is generally believed to be of Pleistocene origin, while that from Engis, described by Schmerling in 1833, is evidently much more recent. The origin of the well known Neanderthal calvaria has always been doubtful, but its extraordinarily heavy brows and low forehead gave it an interest at the time of its discovery, which is not lessened now that very similar skulls have been found under better authenticated conditions.

The Moulin Quignon jaw, which created so much discussion for a few years after its discovery in 1863, has long since been put aside as lacking authenticity. But the jaw found by M. Dupont in the Naulette cave is accepted as that of a human being that lived with the mammoth. The human bones from the caves of Aurinac, Cromagnon, Frontal, Mentone and some others were shown by Prof. Boyd Dawkins to be of neolithic age. The skeleton found at a depth of thirty-two feet at Tilbury Docks in 1883 was thought by Sir R. Owen to be of paleolithic age, but Mr. T. V. Holmes has shown that those gravels are of comparatively modern origin, and could not be older than neolithic.

A fresh impetus was given to the study of paleolithic man by the memoir of MM. Fraipont and Lohest, who in 1887 gave an account of two remarkable skeletons found at Spy, in the province of Namur, Belgium. These skeletons are accepted as of the same age as the extinct mammals, with the bones of which they were found associated. The skulls are of a low type, and one of them especially makes a very close approach to that from the Neanderthal, not only in the general form, but also in the great development of the brow ridges and the lowness of the forehead.

A single tooth from Pont Newydd cave, St. Asaph; a piece of a skull from the brick earth of Bury St. Edmunds, and parts of a skeleton from the high terrace gravel of Galley Hill, Northfleet, are believed to be the only well authenticated instances of paleolithic human remains yet found in Britain; and it is only the skeleton last named that is sufficiently well preserved to give any idea of the form of the skull or limb bones. The Galley Hill skull is very long and narrow, the brow ridges are strongly developed and the forehead is low, but not so depressed as in the Neanderthal calvaria. Although it may not be correct to include the Java Pithecanthropus in the genus Homo, yet as it holds an intermediate position between the lowest type of human skull—the Neanderthal—and that of certain apes, it cannot be neglected when considering the early progenitors of man, and its position in the geological series at the beginning of the Pleistocene, if not in the Pliocene, is precisely the place where such an ancestor would be expected to appear.

Although the greater number of the human remains supposed to be of paleolithic age are now known to be of more recent origin or are not well substantiated, yet there are a few which may be accepted as in all probability representatives of the men who made the paleolithic implements. In the latter category may be placed the skeletons from Spy and that from Galley Hill, as well as the jaw from Naulette and the piece of skull from Bury St. Edmunds. The Eguisheim skull and a few other remains found on the Continent of Europe should perhaps be included with these. The famous calvaria from Neanderthal and Canstadt are among the remains of uncertain origin, but, on account of their resemblance to the Spy skulls, are supposed to be of the same age, and to belong to the same race.

If we accept the Spy and other skeletons as the remains of the men who made the paleolithic implements, what do they tell us of the mental and physical condition of those early progenitors of mankind? As a gage of intellectual capacity, we have to confess that their skulls tell us far less than do the relics of their handiwork.

Prof. Huxley's dictum regarding the Spy men was that "the anatomical characters of their skeletons bear out conclusions which are not flattering to the appearance of the owners." They were short and powerful, but must have walked with a bend at the knees. Their skulls were depressed, with strong brow ridges and lower jaws of brutal depth. The Neanderthal skull has been said by the same authority to be the most apelike of human crania yet discovered. At the same time it is highly probable that these paleolithic men were not less intelligent than some of the savage races living at the present day, for their brain capacity seems to have been as great as that of average Hottentots and Polynesians; and with an equal volume of brain we may presume there was an equal intellectual power. Moreover, men of no mean intellectual capacity are known to have possessed skulls of the Neanderthal type.

It may be doubted whether we are right in regarding the Neanderthal type of skull as typical of the paleolithic race, for other skulls referable to this period are less marked in character, and appear to indicate a greater range of form within the race than has usually been supposed. At present we have too few examples to allow of any definite deductions being made; but what we do know points to the paleolithic race having had long skulls (dolichocephalic), in which particular they approach the neolithic race; but differ from them in the greater development of their brow ridges, in their lower and more receding foreheads and in their shorter stature.

That paleolithic man possessed considerable mechanical skill is shown by the well fashioned flint implements that have been found; and the striking outlines of animals and men incised by him on pieces of ivory and bone, as well as the clever carvings in similar material, is evidence of no little artistic ability. And further, if we bear in mind how little of his work has been preserved to us, and how much that was perishable must have entirely disappeared, we shall be inclined to credit our paleolithic ancestors with a somewhat higher social status than we have usually supposed them to have enjoyed.

* Abstract of presidential address to the Geologists' Association, delivered at the annual meeting, February 4, by Mr. E. T. Newton, F.R.S., and published in Nature.

THE HORNED RAVEN IN THE ZOOLOGICAL GARDEN AT LEIPZIG.

VISITORS to the bird house in the Leipzig Zoological Garden are surprised to see a long-legged raven with a horn on its bill. Its face and throat, which are without feathers, are bright red, and its restless eyes are protected by red lids with heavy lashes. The bird is about the size of a turkey and makes a disagreeable impression on the spectator, especially when he has a piece of the raw meat with which he is fed in his bill. He generally carries it about for a long time before eating it, as if he were enjoying his prey. Those that are confined in the aviary with him prudently keep out of his way, especially since he swallowed a poor parrot, feathers and all, that happened to come too near him.

THE HORNED RAVEN IN THE ZOOLOGICAL GARDEN AT LEIPZIG.

This raven belongs to the horned raven species (Tmetoceros), distinguished specially by its long legs. The fourth toe has only one joint and there is a short web between the second and third toes. The bill is remarkably large, is flattened at the sides and the edges do not meet in the middle. The tail and wings are short. These birds remain on the ground most of the time, where they seek their food, which consists of insects, reptiles and small rodents. In Africa there are three kinds of horned ravens; the one shown in our engraving is the Congo horned raven (Tmetoceros pyrrhops) and is not seen in the Zoological Garden and collections as often as the two other species, which have not only the red face and throat, but also blue markings. The bird shown is a young one and the horn on its bill is small, for it will not be fully developed until it is older, when it will have the form of a quarter circle, and will be thick and hollow.—Illustrirte Zeitung.

Privy Councilor Bansch, engineer of the Emperor William Canal (Baltic and North Sea Canal), is dead.

ENGINEERING NOTES.

In a recent test of speed at Gibraltar the British Channel squadron succeeded in putting in 8,000 tons of coal and getting ready for sea in forty-eight hours.

Expanded metal in the concrete foundation for asphalt pavement in Chicago is said to be called for by recent specifications. The concrete base will be only 4 inches thick, instead of the 6 or 8 inches usually required.

Fireboxes of nickel steel are to be tried in the locomotives on the Prussian government lines. The thickness will be 7 mm. as compared with copper 16 mm., but the cost will be about the same. Stay bolts of nickel steel are also to be tried.

The Transatlantique Company's works at St. Nazaire, France, will shortly begin to construct three large mail steamers for the postal service between Havre and New York, the first of which must be ready in the summer of 1900. The dimensions and power of these steamers will be slightly inferior to those of the English mail steamer Campania, but the speed will probably be the same.

One item in the loss caused to Great Britain by the engineers' strike last year is shown from the statistics of German tonnage. In 1897 there were built for German account in Germany 183,177 tons, against 94,897 tons in 1896; in England 27,419 tons, against 98,807 tons the year before. The total tonnage built for Germany was 212,617 tons, an increase over 1896 of 14,719 tons. In the sum is included 280 tons built in America.

A number of tests have been made with roller bearings on a 3-inch line shaft 80 feet long, running at a speed of 200 revolutions a minute, and found to show a remarkable saving in power, says The American Miller. When running in babbitted boxes the shaft consumed 6·21 horse power, and came to a standstill two minutes after being disconnected from the source of power. After the shaft was fitted with roller bearings the power required to overcome the friction was found to be only 3·01 horse power, and the shaft revolved ten minutes after being disconnected from the source of power.

The Richmond Locomotive and Machine Works has recently presented to Purdue University a full sized model of the front end of one of their two-cylinder compound locomotives, the intercepting valve of which is sectioned so that its operation may be seen. The cylinders are 20 and 30 inches in diameter respectively, and the saddle is surmounted by a full sized smokebox and stack. The whole makes a very complete and impressive exhibit. Members of the railway associations who were at Old Point Comfort last summer will recall seeing this exhibit, and will remember the interest that its presence aroused.

Admiral Popoff, of the Russian navy, is dead, aged 77. He was the inventor of the circular ironclads. The Times is responsible for the following statement: "Our St. Petersburg correspondent announces the death, at the age of 77, of Admiral Popoff, the celebrated inventor and constructor of the two famous circular ironclads, the Novgorod and Vice Admiral Popoff, commonly called the Popofkas, in the Black Sea. Between 1851 and 1855, during the Crimean war, Admiral Popoff captured and sank seven vessels of the allied fleets. He had commanded in the Black and White Seas, and also in the Pacific, and was a member of the Naval Council." Reading that, one would imagine that Admiral Popoff had invented ironclads in 1851.

There has been some doubt as to the working of a gasoline engine at a high level, says The Engineering and Mining Journal. In this connection it is interesting to note that a 10 horse power Weber gasoline engine is running very satisfactorily at Georgetown, Colo., where it is used for hoisting at a mine about 10,000 feet above sea level. A letter from Mr. Frank A. Maxwell, in charge, says: "The engine has been set up over a shaft underground, 1,100 feet from the mouth of the tunnel. The exhaust is carried outside by means of a 4-inch galvanized iron pipe. We began hoisting from a depth of 60 feet and are now down 175 feet. We only hoist from 25 to 40 buckets per day, as we are sinking, and consume about 3 gallons of gasoline. The mine is situated at an elevation of 10,000 feet above sea level."

From experiments at the Basel (Germany) water works it is found that a 160 horse power gas engine, with an expenditure of 1 pound of coke (heating value 7,202 centigrade units), does actual water lifting to the extent of 1,148, 250 foot pounds, says Progressive Age. At the Carlsruhe water works a similar steam pump does 872,500 foot pounds of work per pound of coal. The Deutz works guarantee for gas motors above 60 horse power an hourly consumption not exceeding 0·99 pound of Belgian anthracite and 0·11 pound of coke. In Germany a 100 horse power gas motor now costs from \$6,000 to \$6,500 to put up. While a steam engine uses about 34 gallons of water per indicated horse power, the Basel gas motor uses about 6½ gallons. The Basel motor is the largest as yet built in Germany, and has two cylinders. It is now considered that when we get beyond 50 horse power the gas motor is more economical than the steam engine, when worked with producer gas used direct.

In a recent article on the amount of waste water power in Iceland, Cosmos says the immense waterfalls there would suffice to supply all the 75,000 inhabitants with as much light and heat as they could possibly want, and might also open up the country industrially. The Gulf Stream makes the climate quite bearable, in spite of the high latitude. The three cataracts, Allarfors, Sullfors, and Godafors, could develop a power greater than the largest waterfalls in Europe. Their first duty would be to heat and light the capital, Reykiawik—a town of 4,000 inhabitants, whose population has doubled during the last twenty years—making use of a roaring torrent three miles from the town. The soil of the island, which is of volcanic origin, is rich in minerals, and water power is everywhere available for electrometallurgical processes. It is in a valuable position for scientific observations and for a meteorological observatory, which could contribute useful information as to the laws governing tempests, and might also be of practical service in telegraphing warnings of approaching storms.

ELECTRICAL NOTES.

The Reading Car Wheel Company, of Reading, Pa., has just completed a large electrically equipped foundry. All the molten metal is manipulated by motors; and the blowers, elevators, cranes, drop hoists, and all the other machinery is also operated by electricity. This is one of the most complete installations of electric power yet made in a foundry.

The suburban trains of the Chicago, Milwaukee and St. Paul will soon be operated by electricity instead of steam. President Louderback, of the Lake Street Elevated Railroad Company, gave testimony to this effect while on the witness stand. Mr. Louderback confirmed the announcement later, stating that contracts for furnishing electric power had been entered into with the North and West Chicago Street Railroad Companies. Franchises will be asked for all the companies' lines running out of Chicago.

The extension to the central power station of the Niagara Falls Power Company has practically been completed on the outside. The length of the original section was 140 feet and that of the addition is 286 feet, making the present length of the power house 426 feet. This length covers the entire wheel pit and will afford ample room for installing the seven additional generators necessary to make the product of the station 50,000 horse power. This length covers 10 inlets, which afford a water supply for 10 turbines. The 50 ton electric crane will run the entire length of the interior to assist in placing the machinery. Work on installing the fourth turbine and generator is now in progress.

In a letter to The Engineering News, of New York, Mr. C. H. Snow, of New York University, states that while traveling in Switzerland last summer he came across an engineering curiosity in the shape of a telegraph line with stone poles. This line passes along the fine military road which skirts the west side of Lake Maggiore, and connects Milan with Switzerland by way of the Simplon Pass. The telegraph poles are of gray granite. They average probably 10 inches square and 25 feet high. He was told by a telegraph official that these poles were in use for a distance of 30 to 40 miles, and that their cost in position was about 10 francs (or 8s.) each. The quarries from which the poles were cut are situated just above the town of Stresa. Mr. Snow's informant volunteered the further statement that renewals were now made in wood, the principal cause of dissatisfaction with the stone poles being that they did not stand well against any transverse strain due to the pull exerted when tightening the wires.

To overcome the cost, inconvenience and even danger connected with the ringing of great church bells by hand has now successfully been solved by the application of electrical machinery in the church of St. George, Berlin, says the English Electrical Engineer. A 10 horse power electromotor turns, at a speed of 160 revolutions per minute, a shaft upon which three drums are placed, but which are not keyed to the shaft. At the side of each of these drums a small friction wheel is fixed upon the shaft. When the latter is pressed against the former both revolve, and so move the rope which is fixed at one end to the drum, while the other acts upon the lever of the bell. When the bell gets into the middle of its swing its lifts an eccentric, which loosens the pressure of the wheel upon the drum. This releases the drum, and allows the bell to ring back. A weight acting on the rope and the drum gives sufficient tension to prevent slack ropes from giving trouble. One man only is required to attend to the three bells. He has to start the clutches against the drums. After giving a few impulses this way the bells get up their swing, and the period between the consecutive rings is then automatically maintained.

A rather surprising piece of news comes from Briancon, near Mount Pelvoux. The glacier du Casset has been put under contribution, and a beginning having once been made, we may soon see ice from the famous glaciers offered to cool the famous brands of champagne. The Paris Ice Company had the barbaric idea of getting ice from the glaciers, the last winter having been so mild that their other resources failed. As this winter has been exceptionally mild again, they may already look out for another glacier. The foot of the du Casset glacier is at an elevation of 6,600 feet, and the approach not difficult. Thus the firm of Têste, Pichat and Moret, of Lyons, were, according to the Bulletin Technologique, able to put up a telpher line about 7,000 feet in length within five weeks. There are three cables, 0·7, 0·6, 0·4 inch in diameter; the first carries the ice blocks up to 3 cwt. in weight, the second the empty boxes or irons which hold the large blocks, and the third is the pull rope. No mechanical power is needed, the full boxes pulling up the empty ones. The line is supported by 14 wooden structures; the difference in level between the charging and discharging stations amounts to 1,400 feet. The ice carts into which the blocks are laden have a drive of eleven miles to the railway. About ten tons are brought down per hour.

There are at present 64 German towns provided with electric traction systems, as compared with 44 a year ago. Besides this, 26 towns have electric tramways in course of construction and 30 more have extensions in hand. Reckoned up to September 1, 1897, the total length of the lines, according to the Electrotechnische Zeitschrift, was 594 miles, as compared with 364 miles on August 1, 1896, these figures representing 843 and 533 miles of track respectively. The number of motor cars running was 2,255 in 1897, as compared with 1,571 in 1896, and the capacity of the railway generators in use is estimated at 24,920 kilowatts, as compared with 18,560 for the previous year. It is interesting to compare the figure 24,920 kilowatts with the plant capacity of the German electric lighting stations, which amounted to 67,340 kilowatts—exclusive of accumulators—on March 1, 1897. The overhead trolley system is used almost exclusively, and only some short lines in Berlin and Dresden have underground conduits. Accumulators alone are used on seven lines, including that between Charlottenburg and Berlin—five miles of double track—a short section in Frankfort and one of the Hanover lines, while "mixed" systems are used only in Hanover and on a short section of line in Dresden, the latter town having thus samples of three systems, overhead, underground and the Hanover system.

SELECTED FORMULÆ.

Non-poisonous Fly Paper.—Prepare a strong decoction, or, better still, a tincture, of quassia raspings, and add to it a warm mixture of 300 parts Venice turpentine, 150 parts of poppy seed oil and 60 parts of honey. This preparation should be spread thickly on strong paper.—Pharm. Post, xxx., 328.

A Perfumed Disinfectant.—To remove the inconvenience suffered by travelers through the disinfecting process of quarantine stations, Gawolowski recommends the application of a disinfectant prepared by introducing sulphurous acid gas at a low temperature into alcohol until saturated, and then adding thymol and suitable perfumes.—Pharm. Centralh., xxxviii., 424.

Inking Over Erasures.—A correspondent of Machinery writes: "I inclose a piece of tracing cloth which I think would be of interest, as you will notice the lines have been erased in two places, and one of them polished over again, which makes a good surface to ink on and does not catch the dirt as the unpolished part would. The polish is put on with French chalk or soapstone and then rubbed down with a good clean white blotter. It is best to split the blotter to insure its being clean, and to have two grades of chalk, one hard and one soft, the latter to be used first, then the hard."

Liquid Silver Polish.—Try one of the following:

1. Prepared chalk or whiting	2	ounces.
Water of ammonia	2	"
Water, enough to make	8	"
2. Oxalic acid	1	"
Crocus martis	2	"
Whiting	4	"
Water, to make	1	pint.

Mix, and shake before using. This preparation may be used dry (omitting the water), or applied with a little oil with rubbing, and rubbed dry with whiting.

3. Mix 8 ounces prepared chalk, 2 ounces turpentine, 1 ounce alcohol, 4 drachms spirits camphor and 2 drachms water of ammonia. Apply with sponge and allow to dry before polishing.

4. Cyanide potassium	8	ounces.
Alcohol	1	"
Water of ammonia	1	"
Blue vitriol	½	"
Glauber salts	1	"
Soft water	2	gallons.

Immerse the silverware in the bath for a few minutes, rinse with clear water and polish with chamois skin or flannel.

5. Use a saturated solution of hyposulphite of soda, to which a little bolted whiting has been added. Apply with brush or cloth, and rub till the tarnish is removed.—Pharmaceutical Era.

Roach Killer.—You can make a roach poison which is practically harmless to man, by the following formula:

Borax	9	ounces.
Starch	2½	"
Cocoa	1	"

Another preparation, not so inactive as to human beings, is made by mixing:

Angelica root, in fine powder	5	ounces.
Oil of eucalyptus	1	"

Scatter at night plentifully around the haunts of the pests.

The well known insect powder obtained by grinding the flowers of certain pyrethrums is also an excellent insecticide, but not quite so convenient to use as the foregoing. The observations of some experimenters seem to show that the poisonous principle of these flowers is non-volatile, but our experience in their use indicates that these observations are not complete, as the most favorable conditions under which to use it are in a room tightly closed and well warmed. There may be two poisonous principles, one of which is volatile. Disappointment sometimes arises in its use from getting powder either adulterated or which has been exposed to the air and, consequently, lost some of its power. When a good article is obtained and used plentifully under the conditions above indicated, it proves very efficient.—Druggists' Circular.

Wire Rope Grease.—Engineers are sometimes at a loss how to effectually protect wire ropes against corrosion and other injurious influences, which sometimes penetrate to the interior of the rope without giving evidence of corrosion, says Engineering Mechanics. Acid saline waters produce molecular changes in the iron and steel, and create brittleness. When the center core is composed of hempen rope, the tar in the rope is dissolved and becomes spongy, and holds these sulphuric acids in contact with the metal. "Gloss antoline" is the name of a new grease used to coat the cores and wires to preserve the iron. This fills up the interstices of the rope, and makes it impervious to the causes of corrosion or rust, such as steam and acid waters found in the workings of mines or elsewhere, at the same time acting as a constant lubricant to the rope and individual wires, thus obtaining greater flexibility, lessened friction, and maximum durability of the rope. The following tests show the results of its use: (1) Sample, immersed twelve weeks in solution, 1 part salt, 3 parts water, unaffected; (2) sample, ten weeks over steam exhaust; (3) sample, ten weeks in hot water, 40° Fahr.; (4) sample, twenty-two days' strong solution sulphuric acid; (5) sample, twenty-two days' strong solution sulphuric acid at temperature 130° Cent. or 280° Fahr.; (6) sample, twelve weeks in sea water; (7) sample, seventeen weeks in open air, subject to all atmospherical changes; (8) sample, twelve weeks buried in earth, just sufficiently low enough to receive moisture from an overflow of water, 140° Fahr. twelve hours per day; (9) sample, two weeks in strongest solution ammonia. All the above samples were totally unaffected. In a comparative test an unlubricated rope stood 16,080 bends before rupturing, while a lubricated rope stood 58,400 bends before rupturing, or more than double the other. Herbert Cheesman, of the Hartlepool, Eng., Ropery Company, has made wire rope with these results.

A NEW PORTABLE FILTER.

WE represent herewith, from La Nature, a new filter manufactured by Messrs. Prevet & Company, of Paris.

The apparatus consists of a hollow lens-shaped piece of carbon, F, connected with a tube beneath. This carbon is covered on each side with five thicknesses of filtering paper, K, a piece of cloth and another thickness of paper. There are thus formed on each side of the carbon two thicknesses, E E, which are held in external frames, H H, through the intermedium of clasps placed at the sides. The filter, C, thus formed is placed upon a support, D, and put in communication with the aperture at the lower part. Upon this support, D, is placed a case, A, which is provided with screws for holding it in place and with an appendage to permit of its being fastened to a wall. At the top of the apparatus there is a rubber tube which is provided at its other extremity with a tubulure that enters the kitchen faucet. The water under pressure enters the filter, passes through the paper, cloth and carbon and makes its exit through the center free from impurities.

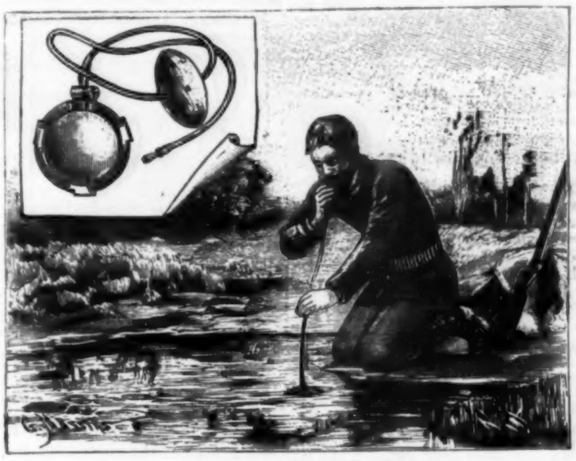


FIG. 3.—THE EDEN PORTABLE FILTER.

The case and the mounting of the filter are made of tin and nickel.

This apparatus is constructed in several forms. The smallest filters give from four to five quarts a day, and the largest about fifteen thousand gallons.

The inventors have also arranged a small model that is capable of rendering the greatest service to tourists and soldiers. This filter, as shown in the cartouche in Fig. 3, is formed like the one above described, but the tube is provided with a cork float for supporting the apparatus when it is immersed in water.

ON THE TREATMENT OF AFFECTIONS OF THE HEART AND THE CIRCULATION BY BATHS, EXERCISES AND CLIMATE.*

I HAVE read with great interest and much instruction the report of the discussion which took place at the meeting of the British Balneological and Climatological Society on January 20. The subject was introduced in a truly scientific spirit by Dr. S. Hyde, and subsequent speakers contributed much to the elucidation of the various problems. It is right and indeed inevitable that any measures and combinations of measures advocated for the treatment of a large and important class of diseases should be subjected to rigid scrutiny and the conditions of their employment defined with as much accuracy as possible. The questions submitted are not those concerning the therapeutical indications of a given health resort or the prescribed plan denoted by the name of a certain physician, however valuable the plan may be and however great our obligations to one who has with zeal, energy and success promulgated his views. Our scope is wider. We recognize that not all our patients whose cases are just suitable for the treatment indicated are able to undertake a journey to a far distant health resort, not all can obtain the services of skilled attendants; and yet it may be possible to put the principles of the treatment into action in their cases. Moreover, it may be that the methods themselves may be improved, for there is no finality in therapeutics.

My purpose is to place before you in a brief manner the views which I had been led to adopt from a review of the evidence which I have been able to obtain and of the cases which have come under my care. I shall consider the therapeutic agencies mentioned in the title seriatim, trying as far as possible to eliminate sources of error, so that we may arrive at a just appreciation of their value.

BATHS.

I have employed cool and cold baths in the treatment of cases of anæmia, including chlorosis, from my earliest days of practice. In many I have prescribed warm and cool spongings in sequence and often douches in addition. I have found—I dare say the observation will be considered a trite one—that the earliest effect of a hot bath or of free sponging with hot water is a quickening of the action of the heart, the pulse becoming soft and relaxed. The cardiac pulsations are at any rate for a time reduced in force. The patient bleeds into his own subcutaneous tissues. The enervating effect of a hot bath or a succession of hot baths is well known and needs no discussion. If after this preliminary warm bath or warm sponging a cool or cold effusion or sponging is practiced, a reversed picture is presented. The subcutaneous arterioles contract, the ventricular systoles are more complete and energetic, though the rate of pulsation is somewhat slowed. Moreover, the inciting of a respiratory reflex causes enhanced movement of blood through the cardiac chambers. A large number of cases, the great majority of anæmia and chlorosis, are accompanied by disorders of the circulation and even by molecular change in the muscular fibrillæ of the heart. Under the bath treatment I have mentioned it is my experience, as I am sure it is of many others, that great improvement has resulted. In some cases the cold bath is used without the preliminary warm, but it is needless to say that in some the shock then is too great.

In the treatment of like circulatory disorders special baths have been in use for a very long time. In Germany Schwalbach (Langenschwalbach) has been in repute for ages. Sir Francis Head, in his "Bubbles from the Brünnens," described it about the year 1831. The water at a temperature of 50° F. is effervescent with carbonic acid. It is true that the mild ferruginous water swallowed is an integral part of the system, but a bath is prescribed about two hours after breakfast, its use being omitted every third or fourth day. At Schlangenbad, in the neighborhood (six miles from Wiesbaden), the springs are mildly alkaline, of a higher temperature (from 77° to 90°), containing two cubic inches of carbonic acid gas to the pint. They are known to calm the perturbations of a nervous heart, and a rhapsodist says of them: "Vous sortez des eaux de Schlangenbad rajeuni comme un Phœnix—la jeunesse y devient plus belle, plus brillante, et l'âge y trouve une nouvelle vigueur." Beneke, in 1859 and 1861, and Groedel, in 1878, adduced evidence to show that the baths of Nauheim, near Frankfort, were beneficial by increasing the force of the heart and restoring compensation in cases of valvular disease. The late August Schott, in 1880, and his brother Theodor Schott, in 1887, subsequently extended the records of experience. Dr. Theodor Schott added a system of definite muscular exercises to the bath treatment and so initiated the combined system which we shall presently consider. In France, Dr. Coulomb, of Bagnols-les-Bains, published some well studied observations of cases of heart disease treated by the baths previously to the years 1883 and 1885, and in 1887 my friend Dr. L. Blanc produced an excellent memoir, translated into English, on Cardiac Affections of Rheumatic Origin Treated at the Thermal Baths of Aix-les-Bains (Savoy). The system of the douche massage as practiced at Aix-les-Bains, the water being of a temperature of from 90° to 95°, is well known and has been adopted at many of the bathing places in our own country. The cases recorded by Dr. Blanc included 73 of diseases of the mitral valve, 25 of those of the aortic valves and 6 of pericarditis. The chemical constitution of the water at Aix-les-Bains has probably but little to do with its therapeutic effect as used externally in these cases. Its chief value lies in its soft, unctuous quality, due for the most part to the presence of organic matter (barégine), which at the agreeably warm temperature at which it is used adapts it so admirably for the douche massage.

The water of Nauheim is effervescent from the presence of carbonic acid gas. The gaseous character of the water is moderated according to the will of the physician, from a mere slight effervescence to the foaming Strombad, which is charged with the gas in large proportion. I cannot doubt that the effervescent character of the water employed has some therapeutic effect. It probably agreeably stimulates the sensory nerve terminals of the skin, as it causes a cool water to feel more pleasantly warm. One seems to have an experience illustrating this point when one takes a bath in the sea at a time when the wind causes a foaming of the surf; the water seems to be warmer than it really is. Whether there is any really favorable reflex stimulation of the heart itself is an undetermined point. Though carbonic acid gas has some anæsthetic qualities, it is probable that it is the mere air bubbles that do the work. Perhaps the pumping into the bath of a stream of ordinary air would serve all good purposes. Whether the effervescent waters as at Nauheim or the thermal soft waters as at Aix-les-Bains are to be preferred is also a matter of doubt. The skin stimulation in the former case is effected by the natural gas, in the latter by the massage manipulation of the bath attendant, the movements of whose hand accompany the flow of water over the surface.

EXERCISES.

It is perhaps not generally known in what words our own great clinician Stokes first, in 1854, called attention to the value of muscular exercise in the treatment of heart disease. Dr. Stokes, in his work on "Diseases of the Heart and the Aorta," published in Dublin in 1854, thus wrote: "The symptoms of debility of the heart are often removable by a regulated course of gymnastics or by pedestrian exercise, even in mountainous countries such as Switzerland or the highlands of Scotland or Ireland. We may often observe in such persons the occurrence of what is commonly known as 'getting the second wind'—that is to say, during the first period of the day the patient suffers from dyspnœa and palpitation to an extreme degree, but by persevering without overexertion or after a short rest he can finish his day's work and even ascend high mountains with facility" (p. 357). This expression sounds the keynote of reaction against the plan adopted, as a routine practice for a long series of years, of keeping a patient who presented any sign of heart disease in conditions of the most complete muscular repose attainable. Supposing that active disease is not present and not progressing in the cardiac tissues, a coddling policy whereby the heart muscle is kept at a minimum exercise of function is contrary to sound physiology and good practice. Ling, of Sweden, in the early part of the present century established his system of movement cure without, however, any special adaptation to cardiac patients. Saeterburg, of Stockholm, and Zander used gymnastics in the treatment of diseases of the heart and described their experiences, which appear to be very favorable, in the period between 1862 and 1872. The only specially adapted machine in Zander's répertoire seems to have been the chest expander, whereby the trunk was extended and the capacity of the chest increased, the shoulders being drawn upward and backward. By its use it is said the walls of the chest recovered their elasticity, the patient was made to inspire deeply and so obtain full inflation of the lungs, and the effect in developing the chests of young persons was very remarkable. Oertel* adopted and extended the doctrine and practice already promulgated by Stokes. In August, 1885, August Schott, in the Zeitschrift für Therapie, wrote on the value of gymnastics for the diagnosis, prognosis and treatment of heart diseases, and subsequently Theodor Schott incorporated the treatment by muscular exercise with that of the baths of Nauheim as a system adopted and recommended by himself in cardiac therapeutics.† The plan of systematized muscular exercises adopted by Schott was precisely that initiated by Ling—viz., active use by the patient of his voluntary muscles, while an instructed attendant makes a certain resistance to each movement.

In my opinion there is no room for doubt that systematized muscular exercise is an agency of great value in the treatment of disorders of the circulatory mechanism. The mode in which each muscular movement effects its good purpose is no doubt very complex and there is room for much difference of opinion in the interpretation of the various observations. In my own opinion the effect of exercise of the voluntary muscles is an accumulation of blood in the vessels of supply of such muscles and a corresponding relief of congested areas. There is thus in some degree a deviation from the engorged veins and the right chambers of the heart. Dr. Lauder Brunton has said "the vessels which supply the muscles of the body are capable of such ex-

* A paper by A. Ernest Sansom, M.D., F.R.C.P. Lond., physician to the London Hospital, president of the Medical Society of London, introducing an adjourned discussion at the British Balneological and Climatological Society on March 2, 1898.

* See Ziemssen's Cyclopedia, 1884.

† See The Lancet, May 23, 1891, pp. 1143 et seq.

FIG. 1.—THE EDEN FILTER—DETAILS.

FIG. 2.—METHOD OF USING THE FILTER.

tension that when fully dilated they will allow the arterial blood to pour through them alone nearly as quickly as it usually does through the vessels of the skin, intestines and muscles together."* Moreover, in the systematic muscular movements there are alternate contractions and relaxations, the former compressing the blood vessels, the latter freeing their channels. Concurrently there are increased activities of the absorbents and reflex nerve stimulations. In the movements of the trunk upon the lower extremities another set of factors comes into play. The alternate compression and relaxation of the abdominal wall must have a powerful effect upon the blood supply to the abdominal viscera. The tendency must be in the main to cause the vessels of the splanchnic area to become dilated and so to co-operate with those of the voluntary muscles in relieving any turgescence of the right chambers of the heart. The latest doctrines derived from experimentation were placed by Dr. George Oliver before the British Balneological and Climatological Society at the previous meeting on January 28, and I can only add the tribute of my thanks for his valuable observations. My own view accords with his, that during muscular exercise there is a rapid fluid transfer through the capillary walls into the lymphatic and interstitial spaces. It seems to me—forgive me if I adopt the tone of a censor—that there is too much disposition in questions of cardiac pathology to ignore the great lymphatic circulation. One is apt to endeavor to explain morbid affections of the circulatory mechanism by mechanical deviations from the normal of the apparatus of the general circulation. Those who deal with baths and massage know how important the lymph circulation is and must be. If I read the facts aright, it is a disturbance of the correlation between the general circulation and the lymph circulation that brings about dropsy. On the whole, I think the tendency to danger of muscular exercises, even of overstrain, has been exaggerated. In regard to the healthy heart I know that Dr. Clifford Allbutt is of this opinion. He holds that the importance of physical effort as a factor in heart disease has been unduly pressed, the effects of physical stress upon the organ being promptly counteracted by equilibrating machinery. I believe that by gradual training the heart in many morbid conditions can be made to react even as a healthy heart. It is not mere physical strain that constitutes much of a danger, but the concurrence of physical with nervous overstrain. A patient with an enfeebled heart may take pleasurable exercise with advantage, but if he take such exercise at a time of mental anxiety or distress—if he hurry to catch a train, for example—then there may be serious and lasting consequences.

COMBINED EXERCISES AND BATHS.

I think it will best serve a useful purpose if I take a concrete case and suggest a simple plan of treatment in the first instance. Supposing that we have before us a patient convalescing from rheumatic fever and there are fears of some change produced by rheumatic endocarditis about the mitral orifice. The patient has convalesced sufficiently to move about his room. Ought we to put in force the combined treatment at once? I think so. Here is a simple method I have long adopted. In the morning, after a slight first breakfast of a rusk and cup of milk, a well-warmed dry Turkish towel is brought and the patient is instructed to rub the soles of his feet, his calves and his thighs therewith, himself sitting by the side of the bed. Such friction may, of course, be aided by nurse or attendant. If tired, the patient may rest in bed again. Next, while in the sitting position, he is instructed to rub with the towel his upper extremities, his chest and back. Then—and the plan can be carried out progressively from day to day—he is told to make certain movements with the arms, using the towel only or a light cane. The patient, sitting or standing, the spine maintained straight, the towel is held taut in each hand, equidistant from the spine, transversely across the shoulders, the head in front; the arms are slowly elevated to their fullest extent and then brought back to the original position. So the upper thoracic muscles are brought into work. These movements are repeated several times, but always short of the production of any dyspnoea or distress. Then, the hands holding the towel or stick symmetrically, the arms are moved slowly and deliberately to and fro. Later the trunk muscles are exercised, the patient stooping as far as the knees and then elevating the arms. At a still later period the stooping may be as far as the ground, with afterward the erect position with arms extended. Here it may be objected that the danger of detachment of a vegetation to become an embolus presents itself. Such is a possible danger; but I think there is a greater peril of passive thrombi forming on account of slowing of the circulation in the cardiac chambers, when a patient is kept with a torpid heart. To continue the exposition of this simple plan of treatment: after an interval of repose, spongings with warm water are practiced or the patient is allowed for a few minutes to have a warm bath. Note that the feet should always be maintained warm. Lastly, there must be a sponging with cool water—at any rate, with water below the temperature of that of the warm bath. The addition of a little pine oil or sanitas to this is of advantage, causing as it does a slight stimulation of the surface and an agreeable glow. And now only follows the drying with warm towel and the envelopment in the bath gown.

The plan thus sketched out renders the services of a skilled attendant unnecessary and is applicable to patients of slender means. No one should stand between medical man and patient—not an attendant or gymnastic professor, however skilled. But by direction of the medical man the patient himself can perform the needful movements and carry out the plan as an habitual hygienic measure every day of his life. Of course, it does not exclude the adoption by those who can afford it of the more completely systematic plan for limited periods at a bath resort. When a patient does go to such a resort, he should be placed under the care of a medical man of repute accustomed to the direction of the bath system and the movement treatment at the special locality. I emphatically indorse the words of Dr. Hyde condemning the administration of such treatment by persons who claim to be qualified but who are destitute of qualifications legal and moral.—Lancet.

* Cf. Harveian Oration, The Lancet, October 20, 1894, p. 895.

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